FIRST DATA REPORT

ON

NANTICOKE ENVIRONMENTAL MANAGEMENT PROGRAM

NETWORK DATA UP TO DECEMBER 1979

REPORT NO: ARB-TDA-64-80

May 1980

CORRECTIONS

Due to an error in reporting the 1979 Nemp ozone data, the following corrections should be noted and applied to Report No. ARB-TDA-64-80:

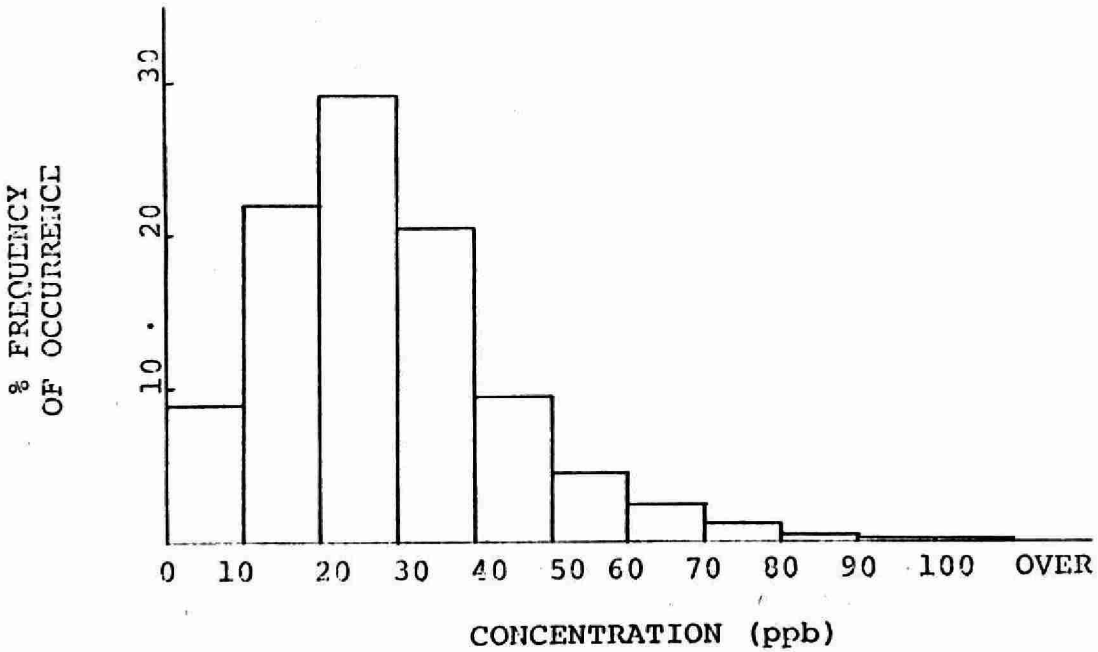
a)	pp 3, paragraph 4	ppm changed to ppb and 236 changed to 148
b)	pp 10, paragraph 1	174 changed to 86
c)	pp 12, paragraph 4	174 changed to 86 and ppm changed to ppb
d)	pp 13, paragraph 1	236 changed to 148
e)	pp 48, figure 2,3,2	should be replaced by the attached figure.

PK/as AR 1-49

NE 11-04-01

OZONE FREQUENCY

OF OCCURRENCE



NANTICOKE
ENVIRONMENTAL
MANAGEMENT
PROGRAM

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NANTICOKE ENVIRONMENTAL MANAGEMENT PROGRAM

NETWORK DATA UP TO DECEMBER 1979

REPORT NO: ARB-TDA-64-80

May 1980

Participants: Environment Canada • Ontario Ministry of the Environment • Ontario Hydro • Stelco Inc. • Texaco Canada Inc.

The data discussed in this report were collected by Moniteq Limited (under contract to Stelco Inc., Texaco Canada Inc., and the Ministry of the Environment), as well as by Ontario Hydro and the Ministry of the Environment (MOE) West Central Region.

The report was prepared by H. Sahota, NEMP Data Analyst and Network Co-ordinator, Air Resources Branch, 880 Bay Street, Toronto, Ontario.

SUMMARY

This report summarizes the data collected in the Nanticoke area by the NEMP, MOE West Central Region and Ontario Hydro networks to December 1979. Yearly frequency distributions are presented for all the parameters considered (sulphur dioxide (SO_2), total suspended particulate (TSP), ozone (O_3), total reduced sulphur (TRS), nitrogen dioxide, carbon monoxide, methane and non-methane hydrocarbons). Seasonal frequency distributions are also presented for the parameters where there were sufficient data (SO_2 and TSP). Data for the chemical composition of airborne particulate matter and precipitation were not available for inclusion in this report, but will be presented in future reports.

The annual average SO_2 concentration for the network during the 1975 to 1979 period was in the 0 to 5 ppb range. The maximum number of hours (18) when one or more of the stations exceeded the hourly air quality criterion (AQC) of 250 ppb occured in 1978. There was only one exceedence of daily AQC (100 ppb) during the five year study period (Jan. 24, 1977). The SO_2 data for all stations appeared to show a seasonal trend, with high concentrations occurring more frequently in winter than other seasons. From the present analyses (1975 to 1979) there was no long term trend visible.

There were in total 19 independent incidents of TSP exceedence of the daily AQC (120 ug/m^3), during 1979. The maximum concentration (235 ug/m^3) and the maximum number of exceedences (9) were observed at Long Point (SW-37)[1]. The yearly average concentration at all stations was less than 50 ug/m^3. Seasonally, all stations showed higher concentrations in the summer than the other seasons, with minimum concentration in the winter.

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1. SW 37 is the station code (see Fig. 1.1). It represents the direction and distance in kilometers of the monitoring station from Ontario Hydro's thermal power plant.

There were no exceedences of AQC (30 ppm hourly average and 13 ppm 8 hourly average) for carbon monoxide. A maximum value of 6 ppm was recorded at Long Point.

There were 3 independent exceedences of the guideline AQC (27 ppb) for TRS. A maximum value of 60 ppb was recorded at Nanticoke Road.

The hourly derived data of NO_2 (obtained by subtracting hourly average NO concentrations from NO_x values) did not exceed the AQC (200 ppb hourly average). The maximum hourly average concentration (83 ppb) was recorded at Binbrook West (NNE 39).

Relatively high concentrations of non-methane hydrocarbons were observed at Cheapside (NNE 10). Hourly average concentrations in excess of 15 ppm were observed at Cheapside, whereas at the other two stations (Walpole South School and Nanticoke Road NNW 08) reported concentrations of about 1 ppm. Initial analysis of wind data did not indicate any correlation with any particular direction and the high levels of non-methane hydrocarbons at Cheapside. Methane levels at the three stations were in the range of 1-2 ppm, which is typical background concentration.

All the three stations (Long Point, Binbrook and Simcoe) reported exceedence of AQC (80 ppm) for O_3. Long Point had the maximum number (167) with Binbrook the lowest (34) and Simcoe was in between at 78. During 1979 the hourly AQC was exceeded 236 times at one or more stations. The relatively high concentrations of O_3 at Long Point require further investigation.

1. INTRODUCTION:

The Nanticoke Environmental Management Program (NEMP) is a joint program between Ontario Ministry of the Environment (MOE), the Federal Government, Stelco, Ontario Hydro and Texaco Canada Inc. The aim of this program is to study the pre- and post-industrial period air quality in the Nanticoke area and to determine the impact of local and distant sources of pollution on air quality.

Nanticoke is situated on the northern shore of Lake Erie. Currently three major industries have started operations - Ontario Hydro, Stelco and Texaco. Table 1.1 outlines the major emissions and their estimated emission rates from these industries. In addition to the pollutants listed in Table 1.1, coal handling facilities at Stelco and Ontario Hydro may contribute to TSP in the form of coal dust. Emissions from Ontario Hydro's Nanticoke Generating Station (NANTGS) come primarily from two 198 m stacks separated by 273 m. Texaco and Stelco emissions emanate from stacks as well as other low level sources. Thus the source configuration in the area is a combination of elevated and low level sources. The map of Fig. 1.1 shows the relative location of these sources.

The land and water configuration at Nanticoke makes its meteorology relatively complex. Mesoscale phenomena such as lake and land breezes affect the dispersion of pollutants, thus complicating air quality research in the area. This also causes the mesoscale flow to show a seasonal bias. During spring and summer, onshore and lake breeze circulation forms a thermal internal boundary layer (TIBL), which in turn may cause fumigation of plumes from elevated shoreline stacks. Fumigation of the plume generally leads to high short-term ground level concentrations of pollutants, which may at times cause exceedence of the air quality criteria. In winter months on the other hand, during the periods when the lake is partly or completely unfrozen it acts as a heat source, which may modify an onshore cold air flow sufficiently to adversely affect the dispersion of plumes from shoreline sources causing, high ground level concentrations.

The network at Nanticoke monitors gases (SO_2, TRS, O_3, NO, NO_x, CO, methane and non-methane hydrocarbons), TSP and chemical composition of particulates, coefficient of haze (COH) and precipitation chemistry. A meteorological tower at Jarvis (NNW 12) operated by Ontario Hydro, measures winds at three levels (10, 32 and 85 m), and temperatures at two levels (10 and 85 m), and an acoustic sounder at Dry Creek (NE 07) collects real time data on the mixed layer height. The map of Fig. 1.1 shows the location of the NEMP network stations along with Ontario Hydro's SO_2 monitors and West Central Region Stations. Table 1.2 shows the parameters measured at each station.

This is the first of a series of reports to be produced on the analysis of data from this network. This report discusses primarily a summary of the data up to December 1979. Succeeding reports will extend the present analysis and will deal in more detail with problems such as episode analysis, trend analysis, correlation between winds and observed concentrations, as well as a discussion on the chemical composition of precipitation, particulates, etc.

2. DATA ANALYSIS:

Table 2.1 lists the parameters which were analysed. Yearly frequency distribution histograms were constructed for all the pollutants. Seasonal frequency distributions were computed only for TSP and SO_2, because of insufficient data for the other pollutants. The number of exceedences of Ontario Ministry of the Environment (MOE) air quality criteria at each station, as well as for the entire network, were also examined. In addition to frequency distribution analysis for TSP, means from a 6 day sampling interval were compared against the means from a 3 day sampling interval, to establish if there was a significant difference between the two (see Appendix).

2.1 Analysis of SO_2 Data:

This analysis is based on hourly average SO_2 concentrations obtained from Ontario Hydro's network (1975-1979), MOE's West Central Region stations (Cheapside and Simcoe 1976-1979) and the NEMP network (1979). Table 2.1 shows the number of monitoring stations for the entire network for 1975 to 1979 and Table 2.2 shows the percentage valid data for the entire network. Figures 2.1.1 to 2.1.5 and Table 2.3 show the yearly frequency distribution of hourly SO_2 concentrations Figures 2.1.6 to 2.1.10 and Table 2.4 show the seasonal* distribution. These figures show that the majority of the data is in the 0-5 ppb range. On a seasonal basis, however, Figures 2.1.6 to 2.1.10 show that concentrations are higher during the winter period. In winter, the frequency with which SO_2 concentration exceeds 15 ppb is higher than during the other seasons.

Table 2.5 summarizes the difference between the seasons. It shows by season the frequency with which SO_2 concentrations exceded the (arbitrary) 15

* Winter = Dec-Feb; Spring = March-May; Summer = June-Aug; Fall = Sept-Nov.

ppb level. The relatively higher SO_2 concentration during the winter season could be due to the following reasons: (1) During winter, stable conditions exist in the boundary layer, resulting in limited vertical mixing of low level pollutants. Any low level source such as oil fired furnaces for households and industrial heating in the region and increased electrical demand could contribute to the relatively high levels of SO_2: (2) The long range transport of SO_2 could also contribute to the high concentrations significantly (Fleming, 1979). The long range transport of pollutants is a complex phenomenon which is dependent on various meteorological parameters. Therefore it requires further investigation before we are able to assess its impact on air quality in the Nanticoke region: (3) Onshore flow, high winds and thermal instability when the lake is not completely frozen over may cause the plumes from shoreline sources to impinge on the local area resulting in large short-term ground level concentrations (Misra and MacMillan, 1979). Further analysis of data is required before we can identify with more certainty the extent to which each of the above phenomena contribute to the higher concentrations during winter.

With the present data base it is difficult to detect any significant difference between SO_2 concentrations in spring, summer and fall. In view of the lakeshore environment of the region, plume fumigation studies and modelling (Portelli, 1979; Misra, 1980) indicate that there might be a secondary peak in the concentration histogram during spring and summer due to interaction of TIBL with the shoreline plumes. One of the reasons we do not see this peak for spring and summer may be due to the present design of the network. This possibility is presently being investigated in a special study of plume fumigations.

Table 2.6 shows the network exceedence of hourly AQC. The maximum number (18) of hours when one or more of the stations exceeded the AQC of 250 ppb occurred in 1978. From 1975 to 1979 only one exceedence of the daily AQC (100 ppb) was observed. There were no exceedences of the annual AQC (20 ppb).

Figures 2.1.11 to 2.1.14 show the spatial distribution of daily average SO_2 concentrations during Winter, Spring, Summer and Fall.

The spatial distributions of SO_2 concentrations during Spring, Summer, and Fall (Figs 2.1.13 to 2.1.15) conform to the shape of a long term[1] plume following a mean WSW wind direction. Note the upwind spread of the long term plume. The short term[2] plume generally shows no upwind spread. During Winter, however, a well defined long term plume is not apparent from Fig. 2.1.12. This may be attributed to the regional scale phenomena described earlier.

2.2 Analysis of TSP Data:

TSP data were available from Oct. 1978 to Dec. 1979. The data were collected every third day with a 24-hour sampling period. Glass fibre filters were used at all stations, with parallel sampling on Whatman 41 filters at eight stations. The Whatman 41 filters were not used for TSP measurements, but were submitted for detailed chemical analysis (results to be reported in the next quarterly report). Figure 2.2.1 shows the yearly frequency distribution of TSP for the entire network. All the stations have maximum daily TSP values in the 20-60 ug/m^3 range.

There were in total 19 exceedences of the daily TSP criterion of 120 ug/m^3. Long Point (SW 37) had the highest number of exceedences (9). The highest TSP level of 235 ug/m^3 was also recorded at Long Point. These high values at Long Point could be due to its location (on a long sandy beach, Fig. 1.1), where windblown dust is expected to be more prevalent than at other sites.

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1. A "long-term plume" is obtained from long-term average concentrations, and includes the effect of wind direction variations during the averaging period (this results in "upwind diffusion" as shown in the isopleths in Figs. 2.1.13 to 2.1.15).
2. A "short-term plume" is obtained from averaging observations over a few hours, and generally does not show any upwind spread.

Figs 2.2.2 a to d show the seasonal frequency distibution of TSP for the entire network. For summer the peak of the histograms shifted from the 20-40 ug/m^3 range to the 40-60 ugm/m^3 range for all stations. Also the winter concentrations at all stations are lower than those for the spring, summer and fall. The relatively low winter time values could be due to a significant reduction in contribution from wind blown dust in the area, which is suppressed under snow cover.

From the present analysis, no significant spatial variation (seasonal or annual) of TSP levels could be determined, thus suggesting that at present the TSP loading in the area is dominated by windblown dust and long range transport into the area, rather than by local industrial emissions.

2.3 Other Gases:

In addition to SO_2, the NEMP network monitors CO, TRS, O_3, NO, NO_x, methane and non-methane hydrocarbons. In the following sections data for each of the gases is analysed separately, and frequency distribution histograms are presented. Seasonal frequency distributions could not be computed due to insufficient data.

2.3.1 Carbon Monoxide (CO):

The AQC for CO is 30 ppm averaged over one hour and 13 ppm averaged over eight hours. Figure 2.3.1 shows the frequency distribution of CO at Long Point and Binbrook. The hourly as well as eight hourly AQC was never exceeded during the monitoring period. In fact the data was mainly in the range of 0-2 ppm. It can be safely deduced that carbon monoxide levels do not pose any problems.

2.3.2 Ozone (O_3):

The AQC for O_3 is 80 ppb averaged over one hour. Figure 2.3.2 shows the frequency distribution for the network comprised of three stations; Long Point,

Binbrook and Simcoe. Long Point had the maximum number (174) of AQC exceeedences. Simcoe reported 83 and Binbrook only 34. Visual inspection of the data indicated increased levels of ozone during summer, which is due to increased photochemical reactions in the boundary layer. High levels of O_3 at Long Point require further analysis to determine their cause.

2.3.3 Total Reduced Sulphur (TRS):

Figure 2.3.3 shows the yearly frequency distribution (hourly average values) of TRS for the network compromised of Cheapside, Walpole South School and Nanticoke Road. There were three independent exceedences of the guideline air quality criterion for TRS (27 ppb hourly average), one at Cheapside and two at Walpole South School. A maximum hourly average value of 60 ppb was reported by Nanticoke Road. Since the majority of the data (79%) is less than 4 ppb (well below the AQC), TRS levels at present are not of concern.

2.3.4 Nitrogen Dioxide:

The hourly data on nitrogen dioxide (NO_2) were derived by subtracting the hourly NO from the NO_x concentration. Figure 2.3.4 shows the network distribution of NO_2 (Long Point, Binbrook West, Sandusk, Simcoe and Cheapside). The majority of the data is in the 0-12 ppb range. There were no incidents of exceedence of AQC criteria (200 ppb/hr and 100 ppb 24 hour average). From the present data, we can safely deduce that, NO_2 levels in the region pose no immediate problems.

2.3.5 Hydrocarbons (Methane and Non-methane):

Figures 2.3.5 and 2.3.6 show the network (Cheapside, Walpole South School, and Nanticoke Road) frequency distribution of methane and non-methane hydrocarbons. The majority of the non-methane hydrocarbons data is between 0-4 ppm, and 1-2 ppm for methane. The latter is a typical "background" value for methane which has been measured elsewhere ("see for example, Stern"). Relatively high concentration levels for non-methane hydrocarbons in excess of 15 ppm were

recorded at Cheapside. In comparison the other stations reported maximum values of no greater than 1 ppm except for one incident at Nanticoke Road South. Initial analysis of the wind data did not show any significant correlation between any wind direction and high levels of non-methane hydrocarbons at Cheapside. Further analysis will be carried out to identify the source for these high levels.

3. CONCLUSIONS:

During the 1975-1979 period, there were in total 67 incidents of exceedence of hourly AQC (250 ppb) for SO_2. The maximum number of hours when one or more stations exceeded the hourly AQC occurred in 1976 and 1978. (Refer to Table 2.4.) The daily AQC (100 ppb) was exceeded only once (in Jan. 1977), and there was no exceedence of the yearly AQC (20 ppb). The data exhibits a seasonal trend, with higher concentrations in the winter season. As explained in section 2.1.1 there are two or three possible explanations for this, which will be investigated in future reports. At present there is no long term trend evident in the data.

There were 19 independent exceedences of the TSP daily AQC (120 ug/m^3) during 1979. The maximum concentration (235 ug/m^3) and maximum number of exceedences were observed at Long Point Park which is located on a sandy beach and may thus be more susceptible to local windblown dust than the other stations. The annual mean concentration at all stations was less than 50 ug/m^3, i.e. there were no exceedences of the annual AQC (60 ug/m^3).

TSP data also shows a seasonal trend. Higher concentrations were recorded during spring, summer and fall, with lower values during winter, which can be attributed to restriction of wind blown dust by the snow cover. Further analysis is required to identify the relative particulate loading due to industries, wind blown dust, and long-range transport.

During 1979 carbon monoxide, and nitrogen dioxide were below the AQC for each contaminant. The Cheapside and Walpole South School TRS monitors reported 3 independent incidents of exceedence of the AQC guideline of 27 ppb one hour average. Overall the concentrations were between 0 and 0.2 ppb, well below the AQC guideline. At Long Point Park there were 174 incidents of exceedence of the ozone AQC (80 ppm one hour average), 83 at Simcoe and 34 at Binbrook. For

network, there were in total 236 incidents when one or more stations exceeded the hourly AQC. Further analysis is required to identify the cause for higher concentrations of O_3 at Long Point Park than at the other stations. Relatively high levels of non-methane hydrocarbons were observed at Cheapside. The yearly average concentration of 1.2 ppm was almost twice the concentration at the other two monitors (Walpole South School and Nanticoke Road), which could be due to some local source. Further data analysis is required to identify this source. Methane concentrations were in the 1 to 1.5 ppm range and were similar at all the three monitors.

In conclusion, we have identified a seasonal bias in the sulfur dioxide and TSP levels, the reasons for which require further analysis. Except for ozone and non-methane hydrocarbons, the other gases did not exhibit any abnormal pattern. High levels of ozone were observed at Long Point, which needs further analysis. High levels of non-methane hydrocarbons at Cheapside will also require further analysis to determine the cause.

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APPENDIX

In order to accept or reject the hypothesis that the means of three day and six day sampling periods are equal, we apply the test developed by Welch (1947) for populations whose variances are not equal. We cannot apply the standard t-test because of the basic assumption for applying the t-test is that the variances of the two populations are equal.

The statistics 'Z' which is an extension of 't' is defined by:

$$Z = \frac{\bar{X} - \bar{Y}}{\sqrt{\frac{\sigma_1^2}{n} + \frac{\sigma_2^2}{m}}}$$

where: x, y: are the means, σ_1 and σ_2 are the standard deviations and n and m are the populations of each sample.

The distribution of 'Z' assuming $\mu_1 = \mu_2$ and that both populations are distributed normally depends on two degrees of freedom γ_1 and γ_2 and a ratio 'C'. The degrees of freedom are those associated with the variance estimates σ_1^2 and σ_2^2 (that is $\gamma_1 = n - 1$ and $\gamma_2 = m - 1$) and the ratio 'C' is defined as:

$$C = \frac{\sigma_1^2 / n}{\sigma_1^2 / n + \sigma_2^2 / m}$$

TABLE 1A

	3 DAY SAMPLING					6 DAY SAMPLING				
STN ID	$\bar{X}_G$	m	$Ln(\bar{X}_G)$	σ_G	$Ln(\sigma_G)$	$\bar{X}_G$	m	$Ln(\bar{X}_G)$	σ_G	$Ln(\sigma_G)$
22902	42	86	3.74	1.85	0.62	43	43	3.76	1.76	0.57
22904	35	89	3.56	1.87	0.63	35	46	3.56	1.76	0.57
22951	37	97	3.61	1.89	0.64	38	50	3.64	1.77	0.57
22952	33	86	3.50	1.69	0.52	34	39	3.53	1.67	0.51
22953	39	96	3.66	1.79	0.58	39	.51	3.66	1.65	0.50
22954	36	93	3.58	1.89	0.64	35	47	3.56	1.79	0.58
22955	40	85	3.69	1.70	0.53	40	44	3.69	1.59	0.46
22956	40	84	3.69	1.61	0.48	39	41	3.86	1.54	0.43
22957	41	92	3.71	1.71	0.54	41	47	3.71	1.71	0.54
22958	48	74	3.87	1.70	0.53	46	38	3.83	1.23	0.55
22960	45	96	3.81	1.66	0.51	44	48	3.78	1.58	0.46
22961	37	79	3.61	1.80	0.59	34	45	3.53	1.65	0.50

TABLE 2A

STN NO	$Z = \dfrac{\bar{X} - \bar{Y}}{\sigma_1^2/n + \sigma_2^2/m}$	$C = \dfrac{\sigma_1^2/n}{\sigma_1^2/n + \sigma_2^2/m}$	for 95% confidence interval upper significance point
22901	-0,48	0.355	
22902	-0.18	0.37	
22904	0	0.387	
22951	-0.289	0.394	
22952	-0.303	0.320	
22953	0	0.417	
22954	0.186	0.381	1.96
22955	0	0.4	
22956	0.352	0.378	
22957	0	0.338	
22958	0.369	0.323	
22960	0.356	0.381	
22961	0.801	0.442	

From Table 2.A we see that the value of upper 0.05 significance point is always greater than the value of 'C' for all stations ie.

$$Pr\ (Z \geq Z_{stu} \mid C = C_{stu},\ N_3, N_6\ ) < 0.05$$

Therefore with 95% confidence we can accept the hypothesis that there is no significant difference between the three day and six day sampling mean. Also the standard deviation for six day sampling period is less than that of three day sampling period.

Table 1.1

SOURCE STRENGTHS

NANTICOKE INDUSTRIAL COMPLEX

(metric tons/yr)

Source	Particulate	SO_2	NO_2^*
Ontario Hydro (1979)	1,529	155,078	28,650
Stelco (Commenced Operation June 1980)	440**	4320**	4570**
Texaco (1979)	250	7,500	1,100

* Emissions are expressed as NO_2. Actually, the majority of the Nitrogen Oxides are in the form of NO.

** Data based on a 1.22×10^6 tonnes per year production.

TABLE 1.2: SUMMARY OF OPERATING NEMP INSTRUMENTS (Listed by Site). Abbreviations: COH = Coefficient of Haze; HC - Hydrocarbons; MOE/WCR = Ministry of Environment, West-Central Region.

STATION ID (GEO)	SITE NAME	INSTRUMENT COMPLIMENT AND NOTES	MAINTAINED BY
SW37	Long Point Park	SO_2, O_3, NO_x, CO TSP Hi-Vol Comp. Hi-Vol TSP Beta Gauge CoH	NEMP Contractor
SW40	Big Creek	Precip gauge Precip collector	NEMP Contractor
W07	Dogs Nest East	TSP Hi-Vol Comp. Hi-Vol Precip collector Precip gauge	NEMP Contractor
W13	Port Dover	SO_2	Hydro
		TSP Hi-Vol*	MOE/WCR
WNW03	Nanticoke Village	SO_2	Hydro
WNW19	Simcoe Horticultural Station	SO_2, O_3, NO_x, HC	MOE/WCR
WNW20	Bloomsburg	SO_2	Hydro

(TABLE 1.2 Cont'd)

STATION ID (GEO)	SITE NAME	INSTRUMENT COMPLIMENT AND NOTES	MAINTAINED BY
NW03	Nanticoke North	TSP Hi-Vol Comp. Hi-Vol	NEMP Contactor
NNW08	Nanticoke Road	SO_2 H_2S, HC	Hydro NEMP Contractor
NNW11	Jarvis	SO_2	Hydro
		TSP Hi-Vol*	MOE/WCR
NNW12	Jarvis Met. Tower	10 m wind speed/dir 10 m temperature 30 m wind speed/dir 85 m wind speed/dir 85 m temperature	Hydro
NNW15	Livingston	SO_2	Hydro
NNE18	Villa Nova	TSP Hi-Vol Precip. Collector	NEMP Contractor
NO7	Sandusk	SO_2	Hydro
		NO_x	NEMP Contractor
		TSP Hi-Vol*	MOE/WCR
N15	Garnet	SO_2	Hydro
N17	Hagersville South	TSP Hi-Vol Comp. Hi-Vol	NEMP Contractor
NNE05	Walpole South School	SO_2	Hydro
		H_2S, HC TSP Hi-Vol Comp. Hi-Vol	NEMP Contractor
NNE09	Dry Creek	SO_2	Hydro

(TABLE 1.2 Cont'd)

STATION ID (GEO)	SITE NAME	INSTRUMENT COMPLIMENT AND NOTES	MAINTAINED BY
NNE10	Cheapside	SO_2 NO_x, COH TSP Hi-Vol	MOE/WCR
		H_2S, HC TSP Beta Gauge	NEMP Contractor
NNE16	Balmoral	SO_2	Hydro
NNE22	Dufferin North	TSP Hi-Vol Precip. Collector	NEMP Contractor
NNE39	Binbrook West	SO_2, O_3, NO_x, CO TSP Hi-Vol CoH Precip collector Precip gauge	Nemp Contractor
NE07	Dry Creek West	Acoustic Sounder	NEMP Contractor
NE16	Fisherville North	TSP Hi-Vol Comp. Hi-Vol	NEMP Contractor
NE19	Kohler Road	SO_2	Hydro
NE27	Canfield South	TSP Hi-Vol Precip collector Precip gauge	NEMP Contractor
NE41	Canboro East	TSP Hi-Vol Precip collector	NEMP Contractor
ENE11	Selkirk	SO_2	Hydro
		TSP Hi-Vol*	MOE/WCR
ENE17	Rainham Centre South	TSP Hi-Vol Comp. Hi-Vol	NEMP Contractor

(TABLE 1.2 Cont'd)

STATION ID (GEO)	SITE NAME	INSTRUMENT COMPLIMENT AND NOTES	MAINTAINED BY
ENE18	Rainham Centre	SO_2	Hydro
E04	Peacock Pt. Park	TSP Hi-Vol Comp. Hi-Vol	NEMP Contractor
E05	Peacock Pt.	SO_2	Hydro

* MOE/WCR TSP Data was not used in the analysis

TABLE 2.1: Parameters Monitored by Network Shown in Fig. 1-1. No. of Monitoring Stations for Each Parameter are Also Shown in Brackets.

YEAR	PARAMETER	
1975	SO_2	(16)
1976	SO_2	(19)
1977	SO_2	(19)
1978	SO_2	(22)
1979	SO_2	(22)
	TST	(13)
	TRS	(3)
	CO	(2)
	NO_2	(5)
	O_3	(3)
	Methane and Non Methane Hydrocarbons (3)	

Table 2.2: Percentage Valid SO_2 Network Data for the Period 1975 - 1979.

YEAR	PERCENTAGE VALID SO_2 DATA
1975	92 %
1976	92.6 %
1977	90.5 %
1978	84.3 %
1979	90 %

TABLE 2.3: Annual Frequency Distribution of Hourly Average (Network) Concentration of SO_2 (ppb)

	Frequency (%) of Occurrence									
Conc	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-over
1975	69	18	7	3	2	1	0	0	0	0
1976	62	17	9	4	2	2	1	1	1	0
1977	61	17	9	4	4	4	1	1	1	2
1978	58	20	10	5	3	2	1	1	0	1
1979	65	19	7	4	2	1	1	0	0	1

Table 2.4: Seasonal (Winter) Frequency Distribution of Hourly Average (Network) Concentration of SO_2 (ppb)

	Frequency (%) of Occurrence									
Conc.	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-over
1975	54	20	15	5	3	3	1	0	0	0
1976	45	25	11	6	4	4	2	2	1	2
1977	34	18	13	11	6	5	4	2	2	6
1978	40	23	15	9	4	3	2	1	1	2
1979	41	23	14	9	5	3	1	1	1	2

TABLE 2.4: Seasonal (Spring) Frequency Distribution of Hourly
- cont'd.- Average (Network) Concentration of SO_2 (ppb)

	Frequency (%) of Occurrence									
Conc.	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-over
1975	80	14	3	2	1	0	0	0	0	0
1976	78	16	4	1	1	0	0	0	0	0
1977	70	16	6	4	2	1	1	0	0	0
1978	74	14	5	2	2	1	0	0	0	0
1979	64	21	8	3	2	2	0	0	0	0

TABLE 2.4: Seasonal (Summer) Frequency Distribution of Hourly
- cont'd.- Average (Network) Concentration of SO_2 (ppb)

	Frequency (%) of Occurence									
Conc.	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-over
1975	84	10	3	1	0	0	0	0	0	0
1976	75	14	6	3	1	0	0	0	0	0
1977	75	15	5	2	1	0	0	0	0	0
1978	69	19	6	3	1	1	0	0	0	0
1979	74	19	4	2	1	1	0	0	0	0

TABLE 2.4: Seasonal (Fall) Frequency Distribution of Hourly Average
- cont'd.- (Network) Concentration of SO_2 (ppb)

	Frequency (%) of Occurrence									
Conc.	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-over
1975	64	20	9	4	1	1	0	0	0	0
1976	65	19	7	4	2	1	1	1	1	0
1977	73	18	5	3	1	1	0	0	0	0
1878	58	21	10	5	2	1	1	1	1	1
1979	67	23	7	2	1	0	0	0	0	0

Table 2.5: Frequency(%) With Which SO_2 Concentration Exceeds the 15 ppb Level on a Seasonal Basis

YEAR	WINTER	SPRING	SUMMER	FALL
1975	12	3	1	6
1976	21	2	4	10
1977	36	8	3	5
1978	22	5	5	12
1979	34	18	4	6

TABLE 2.6: Number of Times Each Station Exceeded Hourly Average AQC (250 ppb) During 1975 - 1979.

	Total No. of Times Hourly Average Concentration Exceeded 250 ppb				
Station ID	1975	1976	1977	1978	1979
WNW19					2
NNE10				6	2
N07	1	3		2	2
N15					
NNE05					
NNE09	4	3	3	5	1
NNE16	4	4		2	
NNE17	1		3		
NNE20					
NE10	1				
NE19					
ENE11					
ENE18					
E05					
W13				1	
WNW03					1
WNW20		1			
NNW08		3	3	2	1
NNW11		1	1		1
NNW15		2	1	1	
SW37					
NNE39					
TOTAL	11	17 (1)	11	19 (1)	9

Number in brackets denote number of hours more than one station reported exceedence at the same hour.

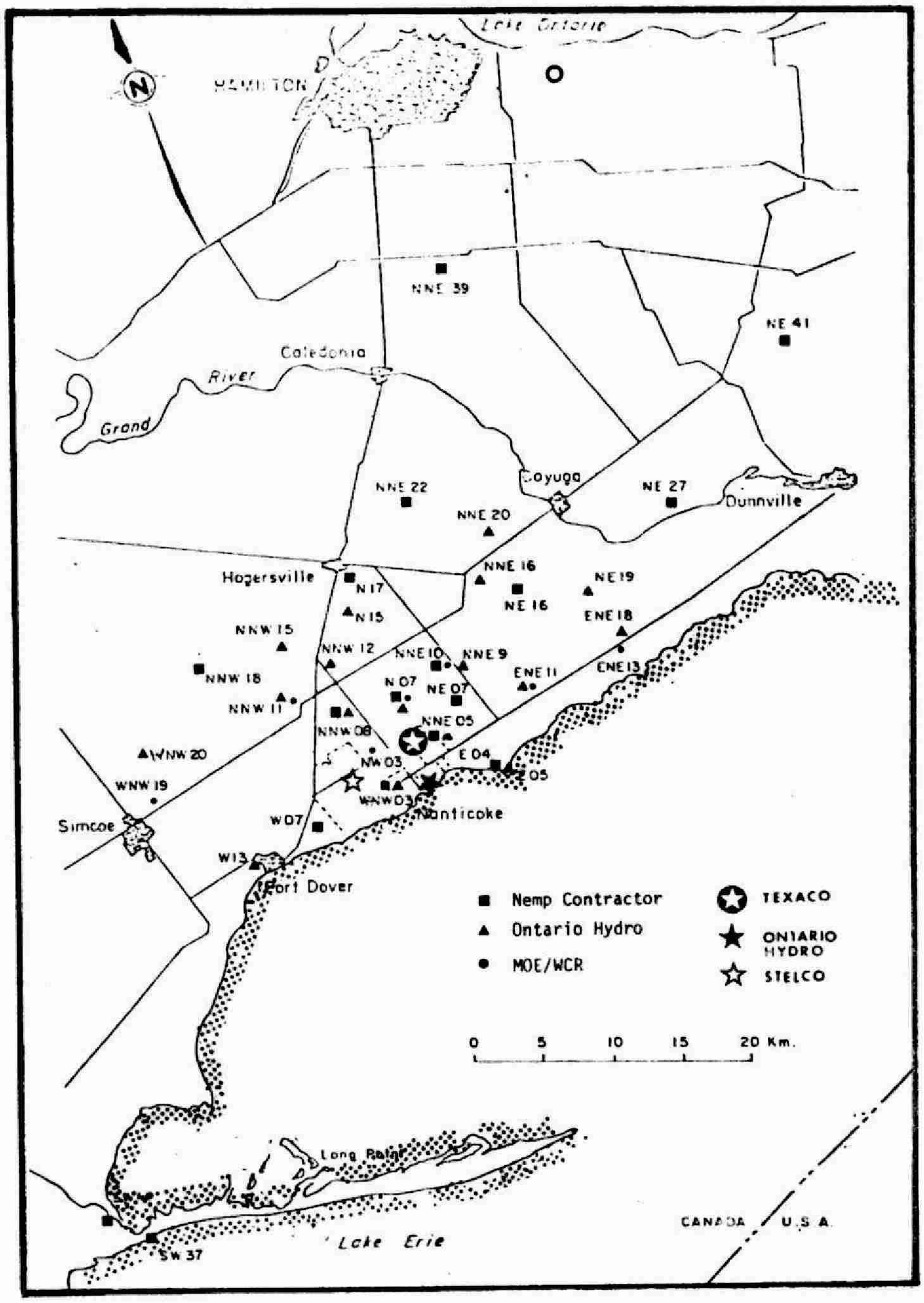

Fig. 1.1: AIR QUALITY MONITORING NETWORK

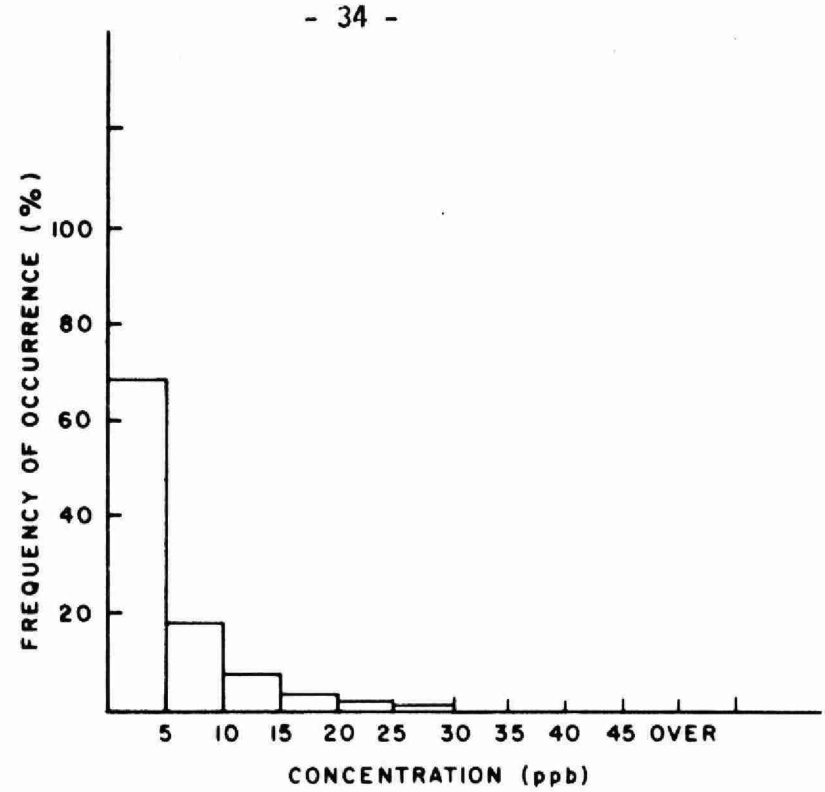

FIGURE 2.1.1: NETWORK FREQUENCY DISTRIBUTION OF SO_2 FOR 1975.

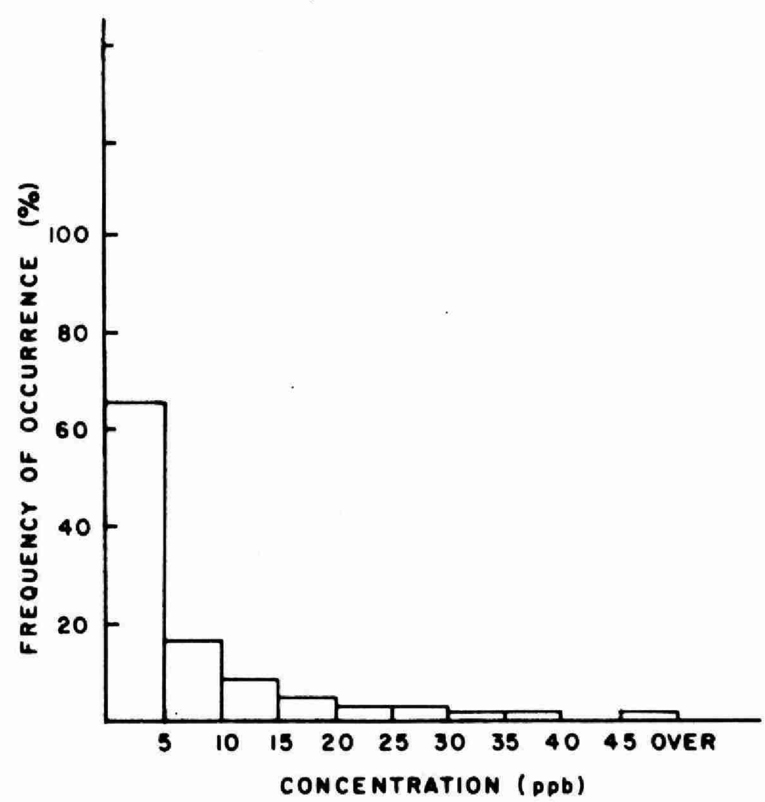

FIGURE 2.1.2: NETWORK FREQUENCY DISTRIBUTION OF SO_2 FOR 1976.

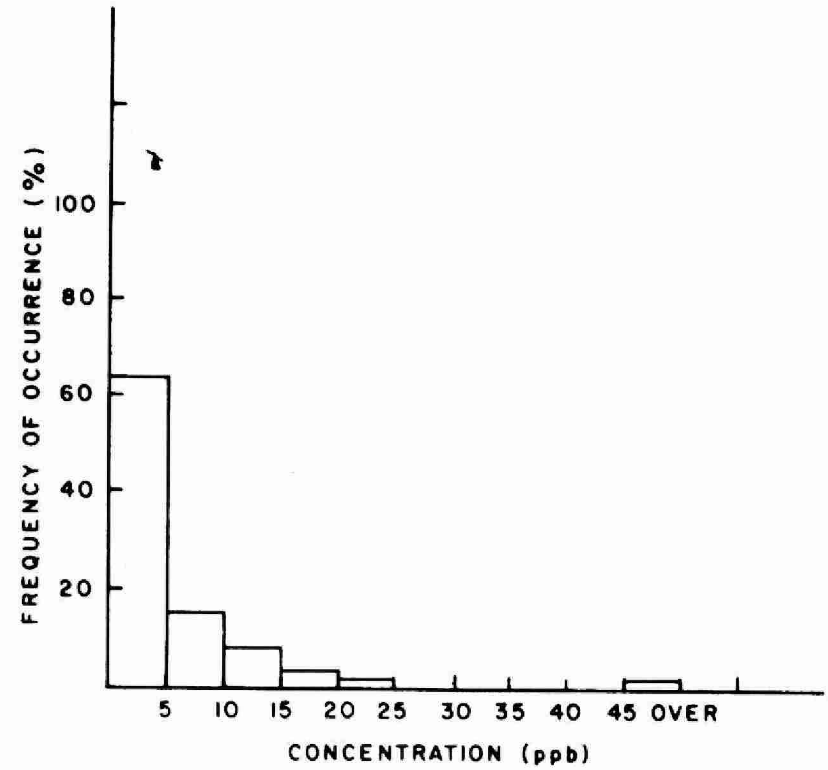

FIGURE 2.1.3: NETWORK FREQUENCY DISTRIBUTION OF SO_2 FOR 1977.

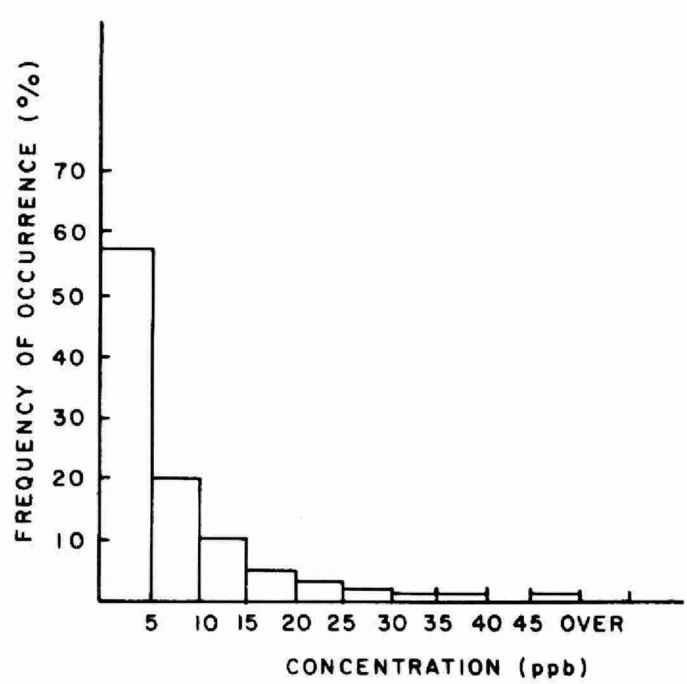

FIGURE 2.1.4: NETWORK FREQUENCY DISTRIBUTION OF SO_2 FOR 1978.

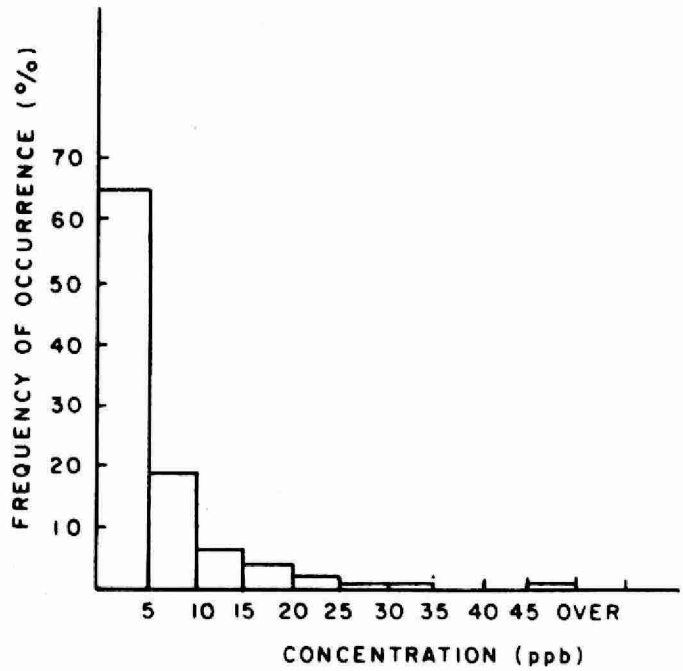

FIGURE 2.1.5: NETWORK FREQUENCY DISTRIBUTION OF SO_2 FOR 1979.

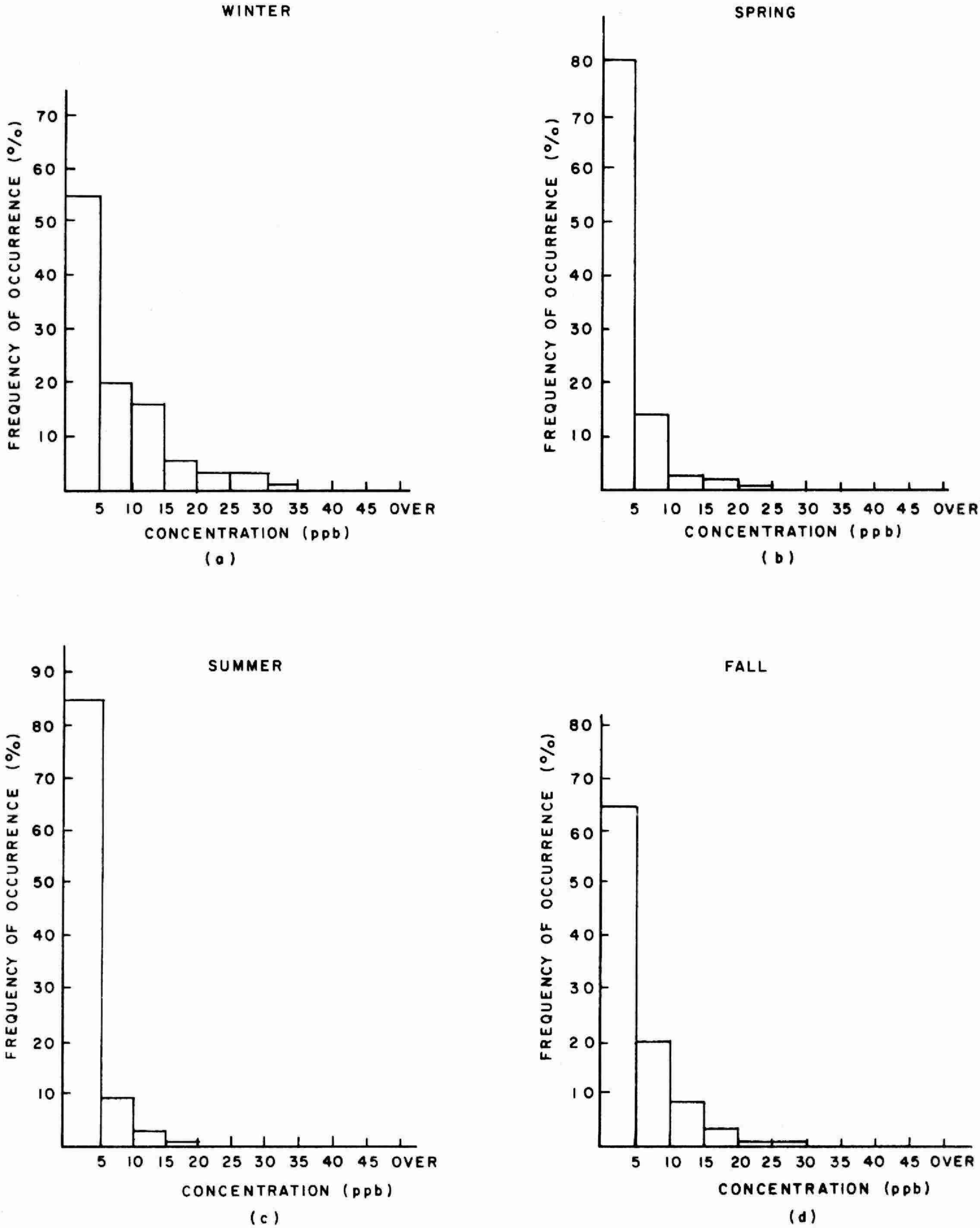

FIGURE 2.1.6 SEASONAL FREQUENCY DISTRIBUTION OF SO_2 FOR THE ENTIRE NETWORK. (1975)

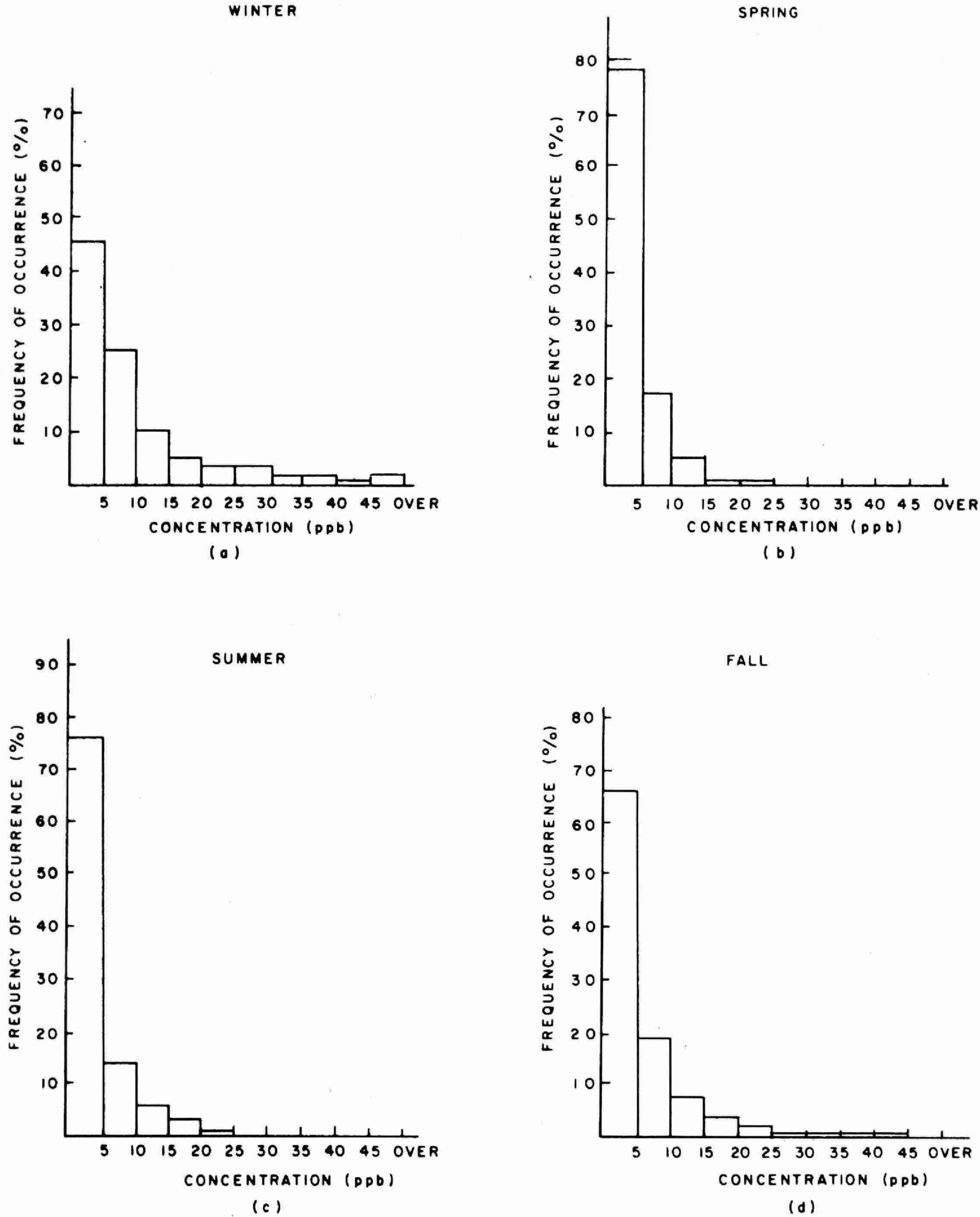

FIGURE 2.1.7 SEASONAL FREQUENCY DISTRIBUTION OF SO_2 FOR THE ENTIRE NETWORK. (1976)

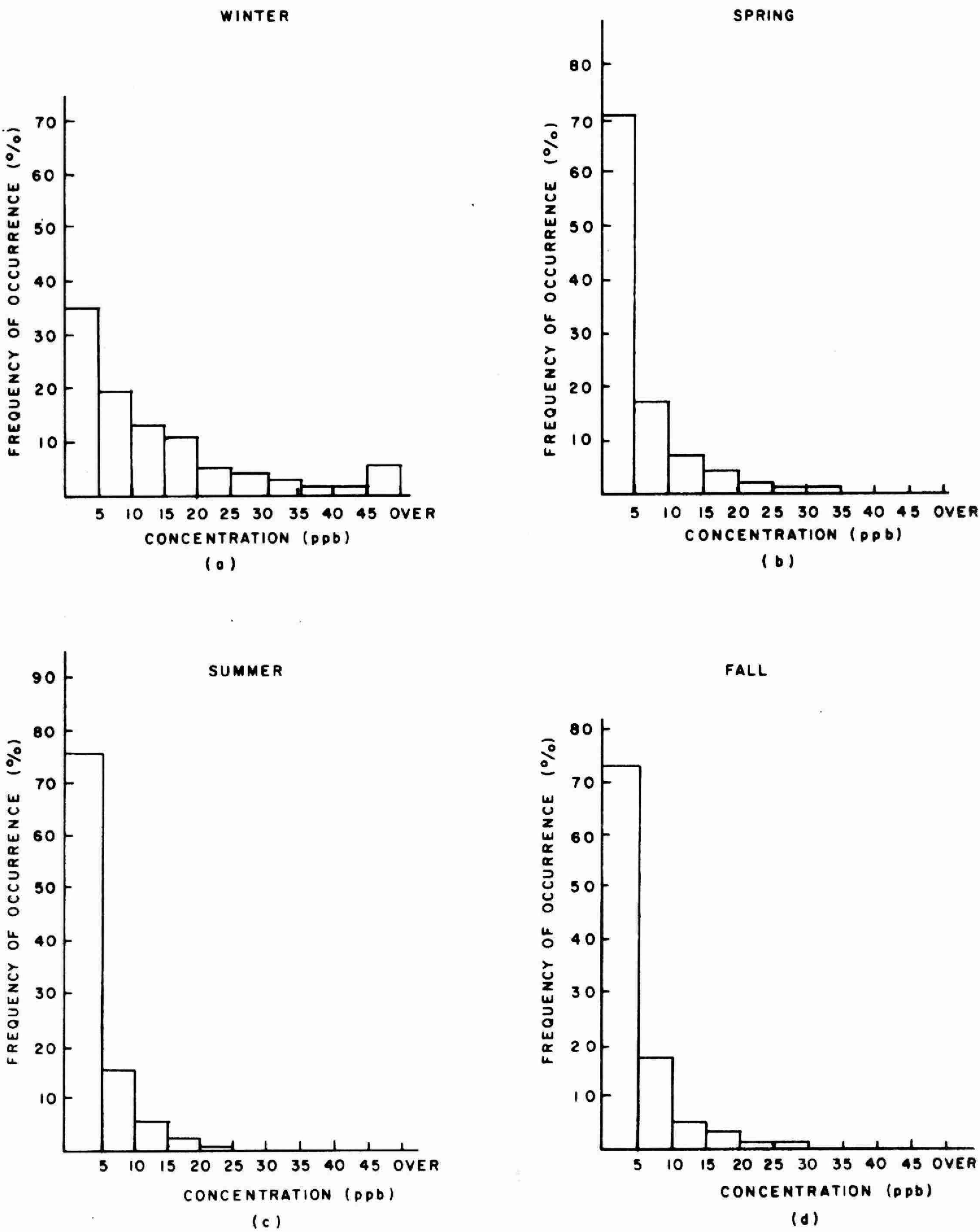

FIGURE 2.1.8 SEASONAL FREQUENCY DISTRIBUTION OF SO_2 FOR THE ENTIRE NETWORK. (1977)

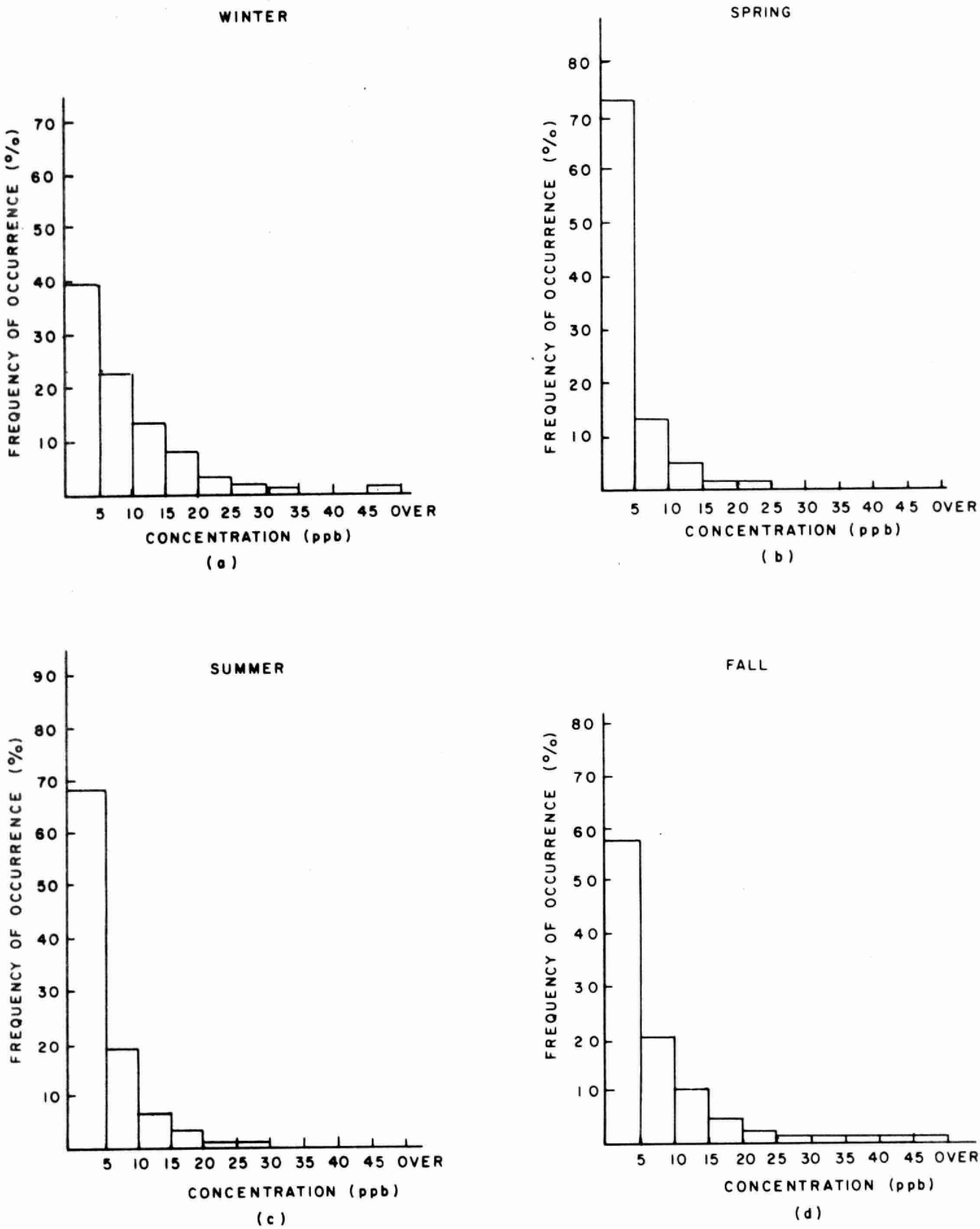

FIGURE 2.1.9: SEASONAL FREQUENCY DISTRIBUTION OF SO_2 FOR THE ENTIRE NETWORK. (1978)

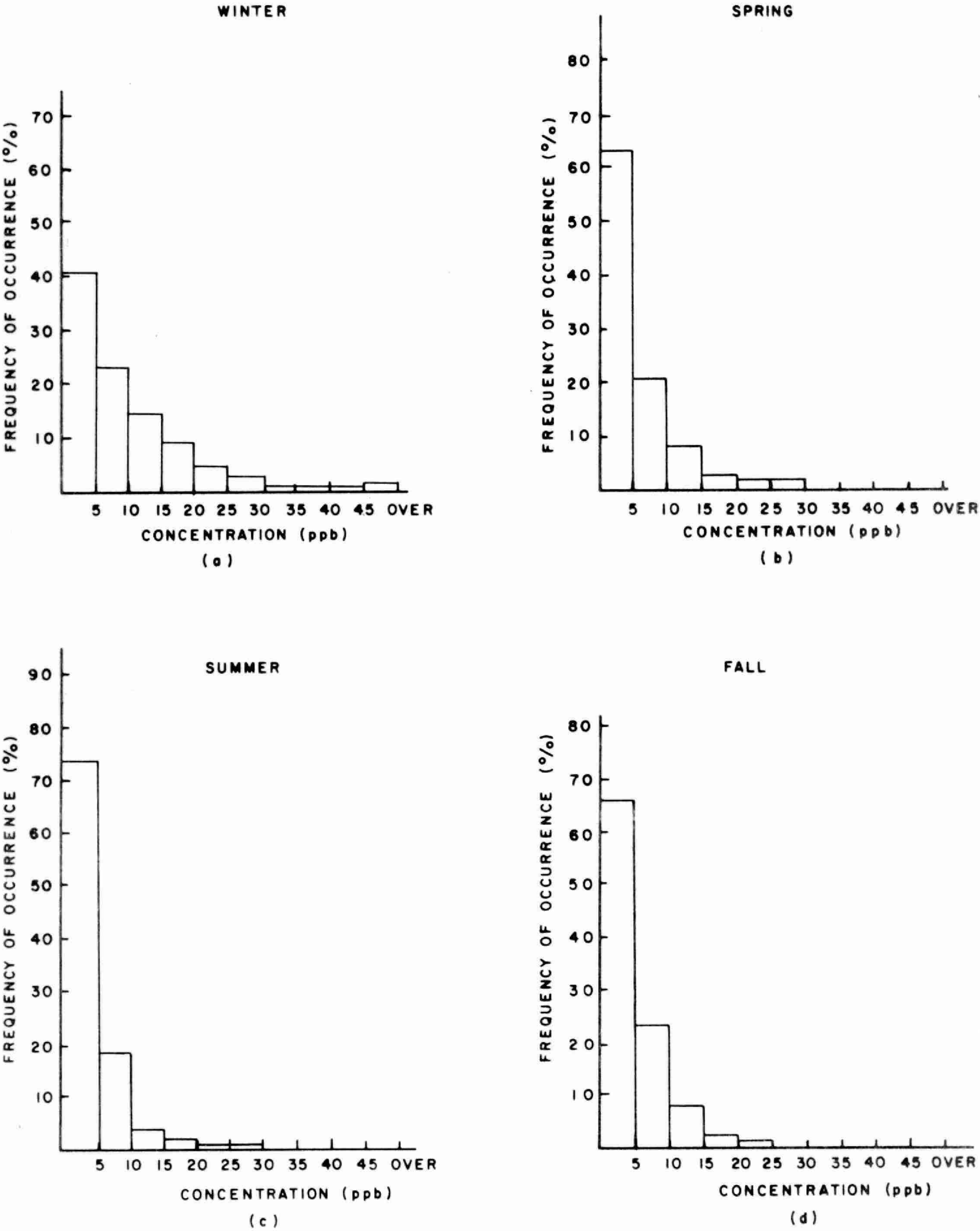

FIGURE 2.1.10 SEASONAL FREQUENCY DISTRIBUTION OF SO_2 FOR THE ENTIRE NETWORK. (1979)

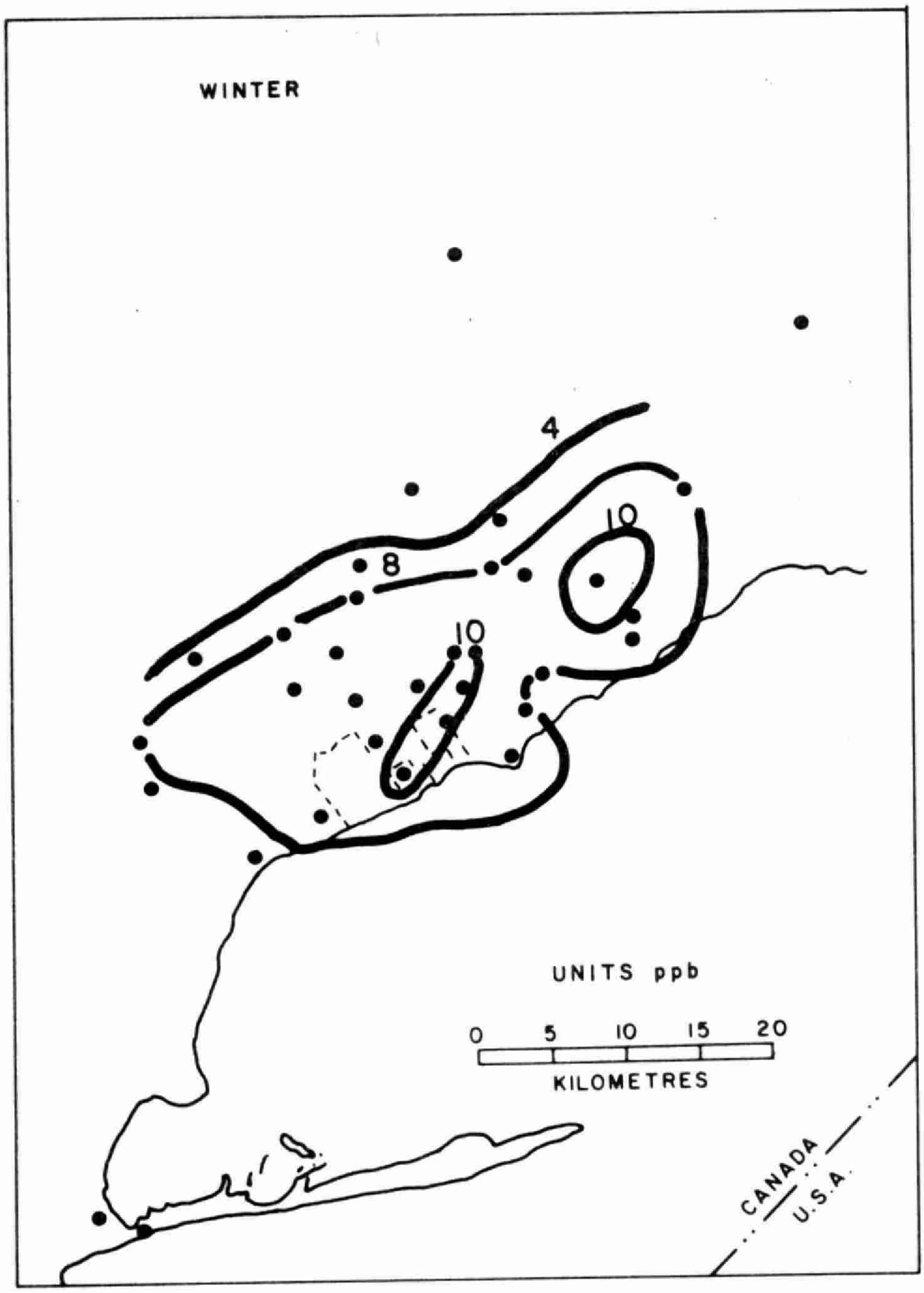

FIGURE 2.1.11: SPATIAL DISTRIBUTION (FOR WINTER) OF HOURLY AVERAGE (FIVE YEAR DATA FROM 1975-1979) CONC. OF SO_2 (CONTOURS ARE IN PPB).

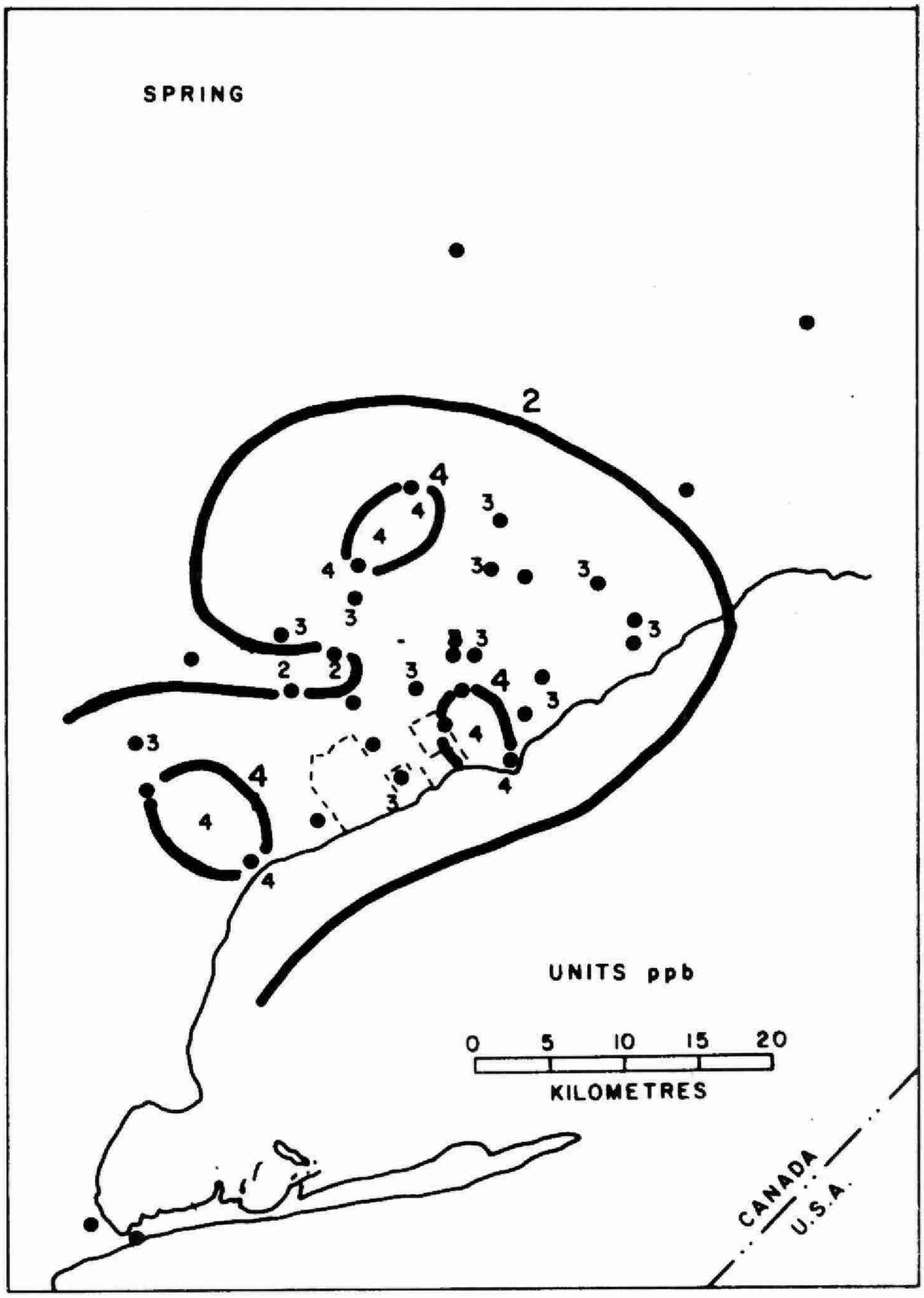

FIG. 2.1.12: SPATIAL DISTRIBUTION (FOR SPRING) OF HOURLY AVERAGE (FIVE YEAR DATA FROM 1975 - 1979) CONC. OF SO_2 (CONTOURS ARE IN PPB).

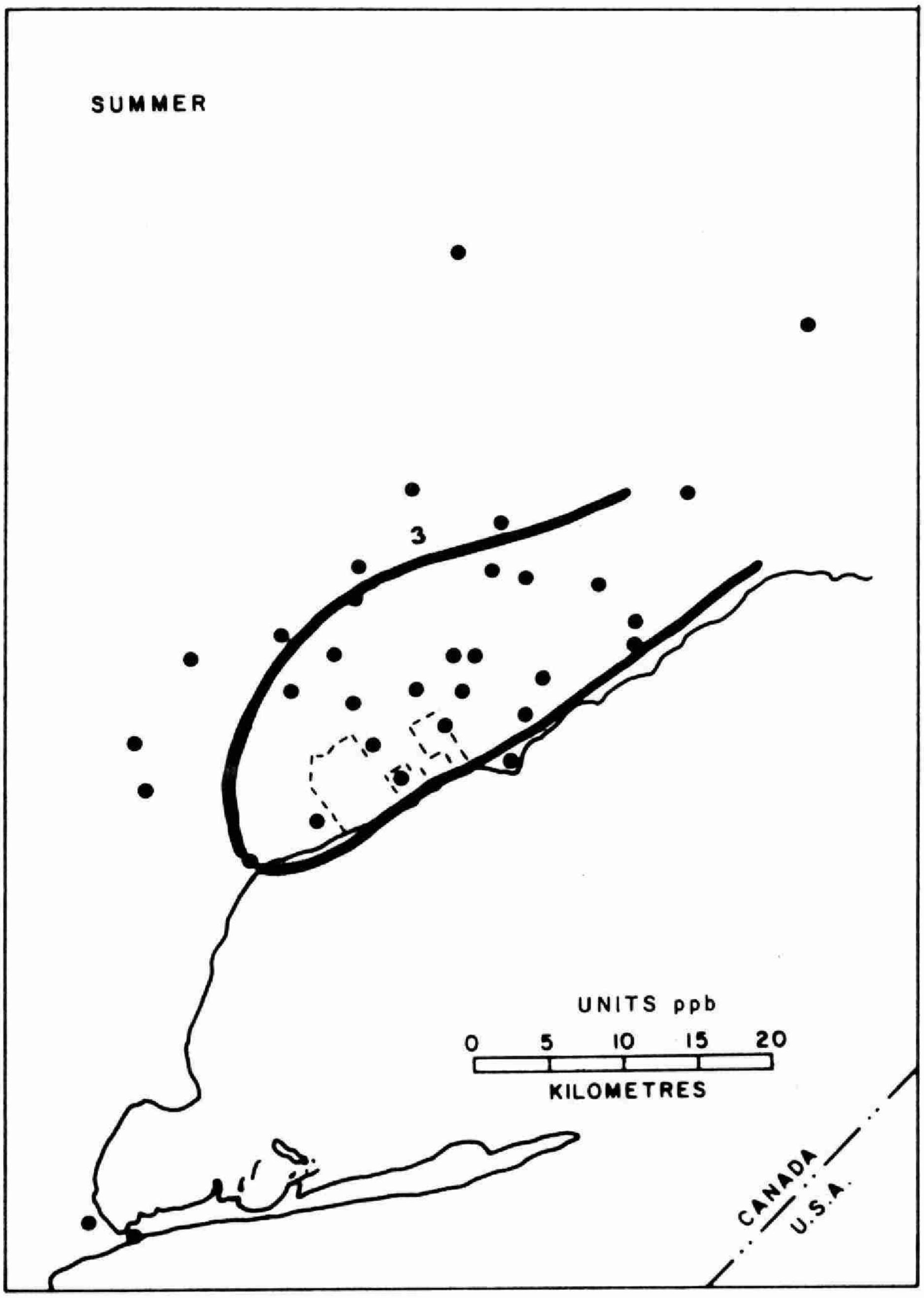

FIG. 2.1.13: SPATIAL DISTRIBUTION (FOR SUMMER) OF HOURLY AVERAGE (FIVE YEAR DATA FROM 1975 - 1979) CONC. OF SO_2 (CONTOURS ARE IN PPB).

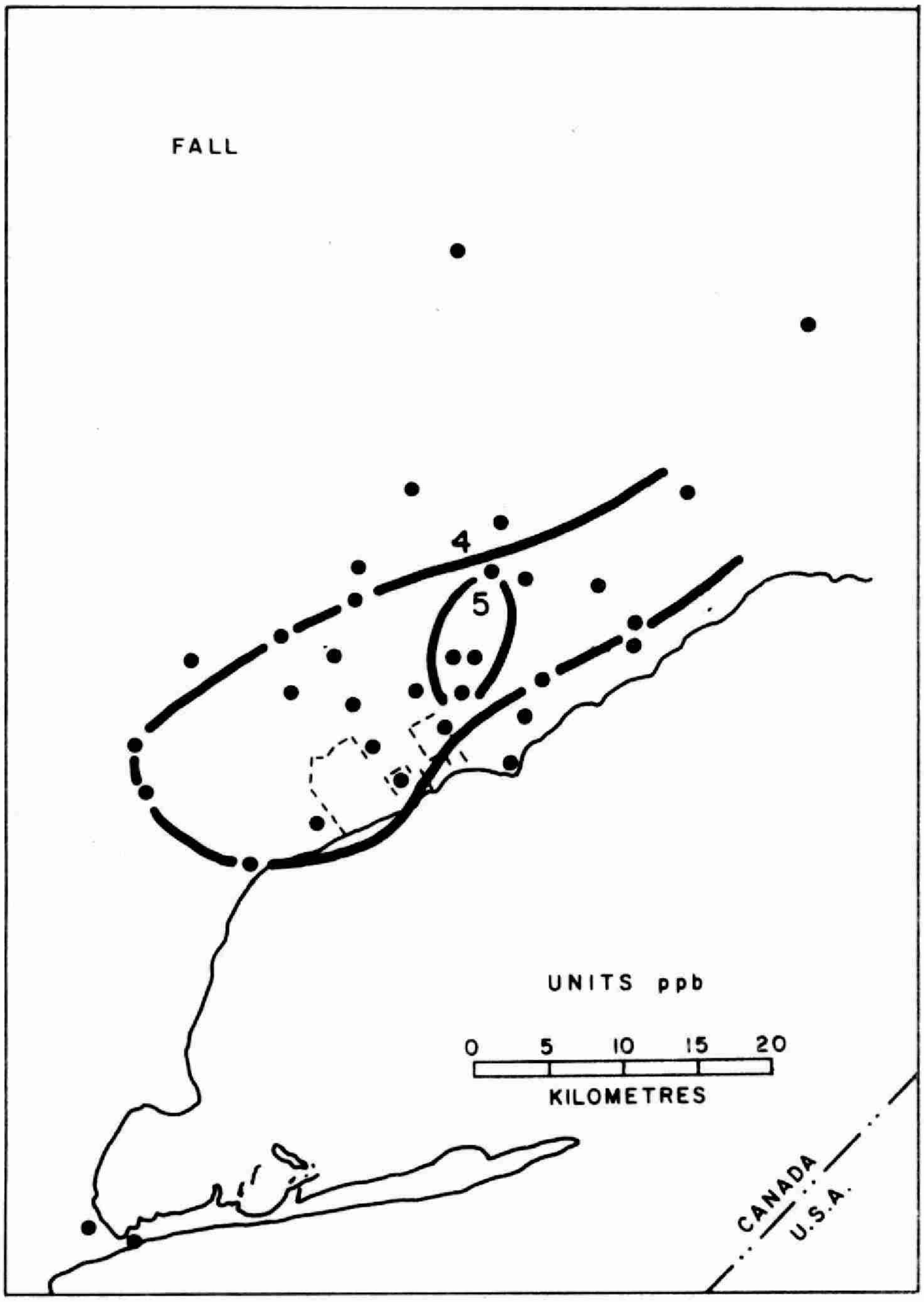

FIG. 2.1.14: SPATIAL DISTRIBUTION (FOR FALL) OF HOURLY AVERAGE (FIVE YEAR DATA FROM (1975 - 1979) CONC. OF SO_2 (CONTOURS ARE IN PPB).

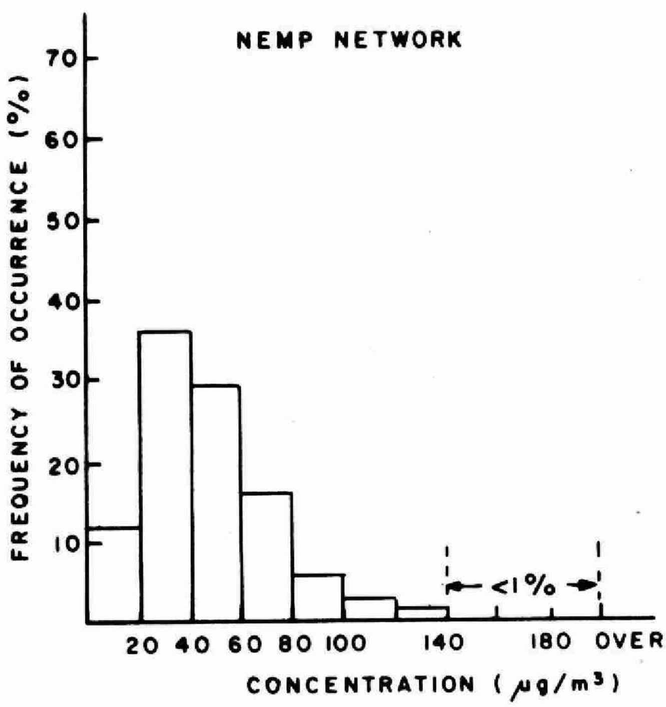

FIGURE 2.2.1: YEARLY FREQUENCY DISTRIBUTION OF TSP FOR NEMP NETWORK FOR 1979.

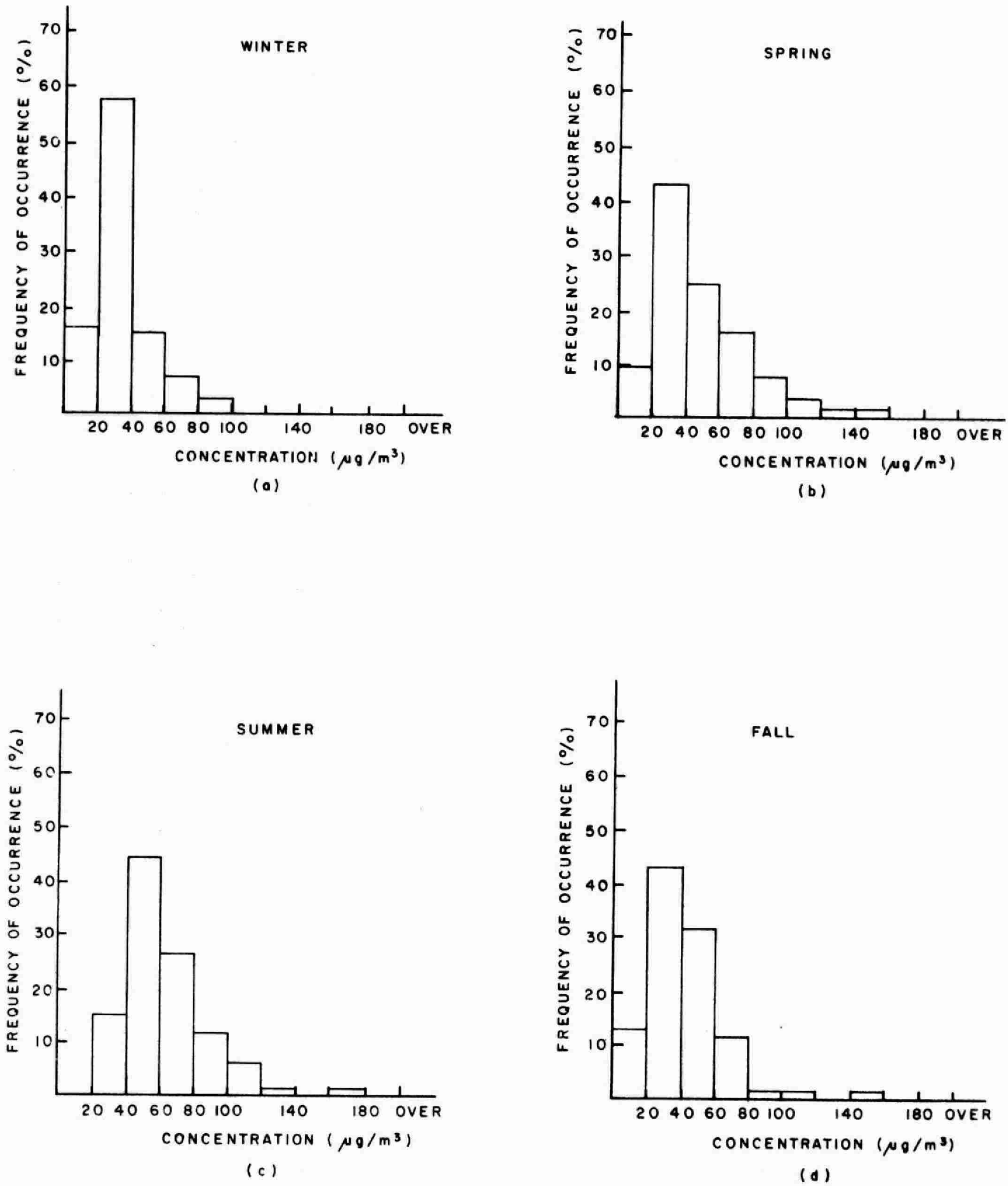

FIGURE 2.2.2: SEASONAL FREQUENCY DISTRIBUTION OF TSP FOR THE NEMP NETWORK FOR 1979.

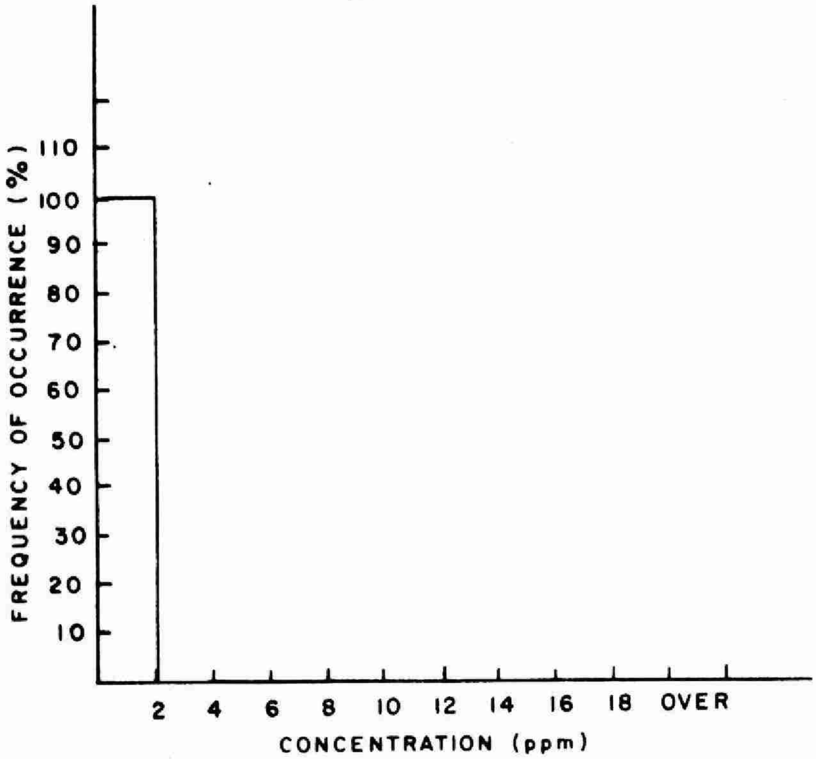

FIGURE 2.3.1: YEARLY FREQUENCY DISTRIBUTION OF CO AT LONG POINT AND BINBROOK FOR 1979.

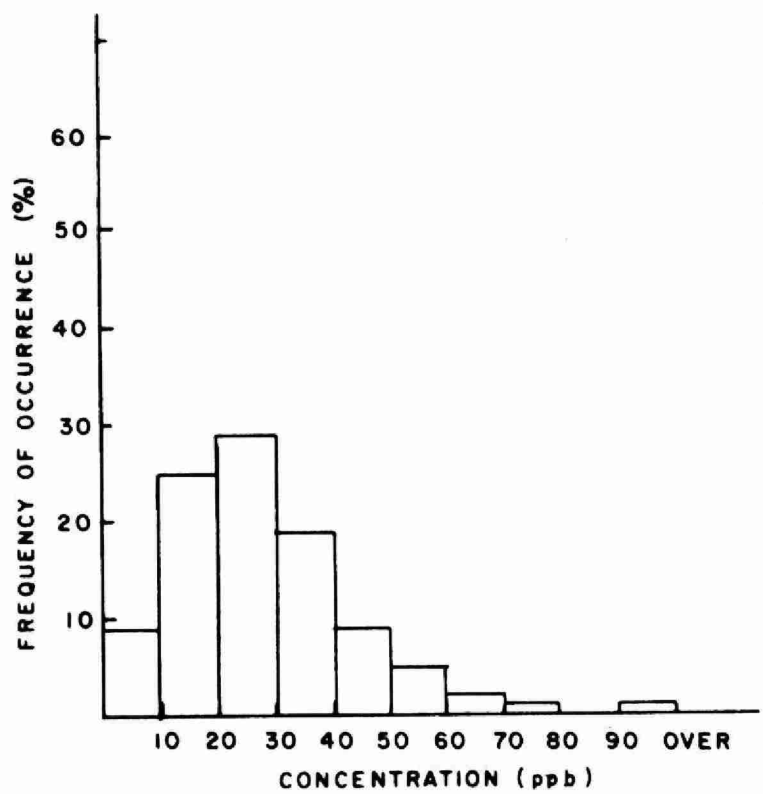

FIGURE 2.3.2: YEARLY FREQUENCY DISTRIBUTION OF O_3 AT LONG POINT, BINBROOK AND SIMCOE FOR 1979.

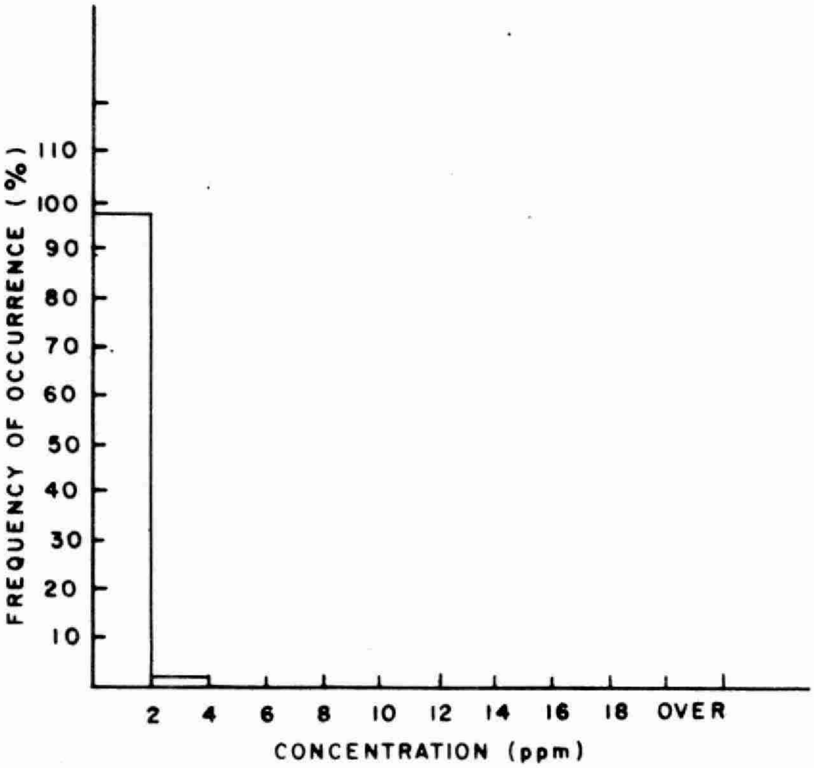

FIGURE 2.3.3: YEARLY FREQUENCY DISTRIBUTION OF TOTAL REDUCED SULPHUR (TRS) AT CHEAPSIDE, WALPOLE SOUTH SCHOOL AND NANTICOKE ROAD FOR 1979.

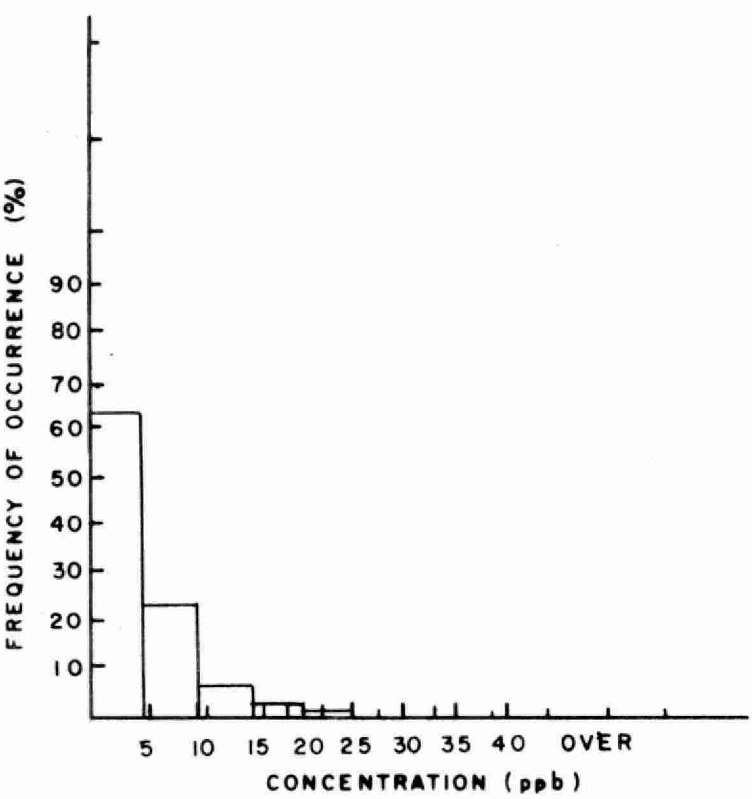

FIGURE 2.3.4: YEARLY FREQUENCY DISTRIBUTION OF NO_2 AT LONG POINT, BINBROOK, SANDUSK, SIMCOE AND CHEAPSIDE FOR 1979.

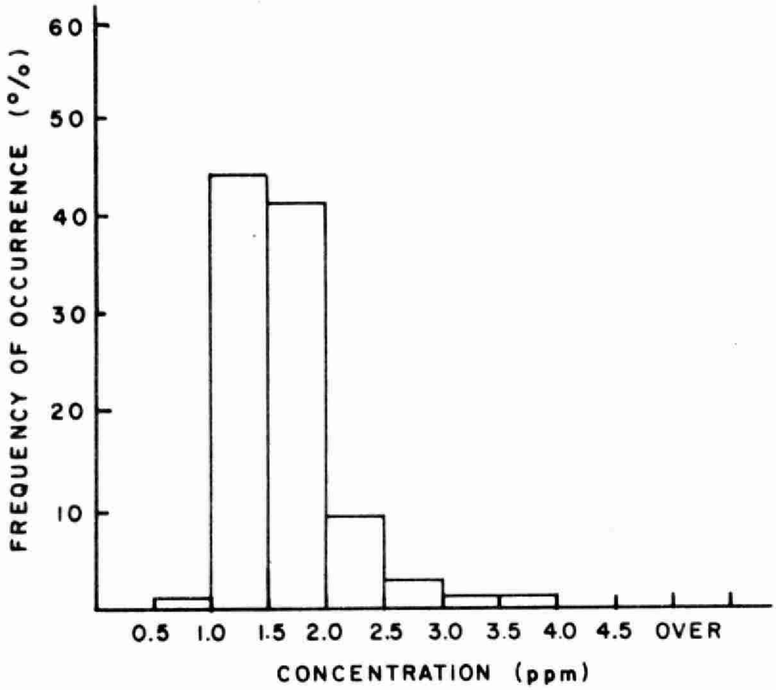

FIGURE 2.3.5: YEARLY FREQUENCY DISTRIBUTION OF CH_4 AT CHEAPSIDE, WALPOLE SOUTH SCHOOL AND NANTICOKE ROAD FOR 1979.

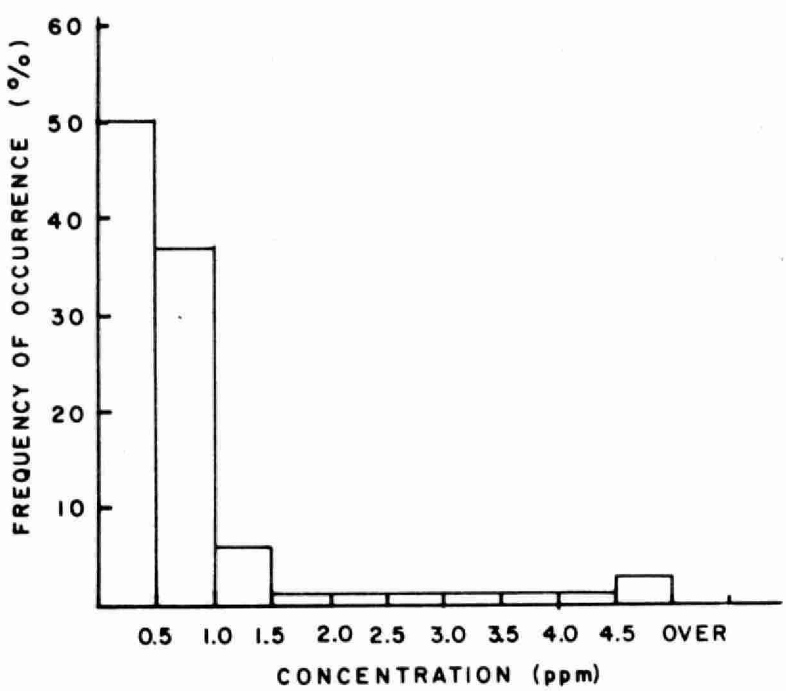

FIGURE 2.3.6: YEARLY FREQUENCY DISTRIBUTION OF NON-METHANE HYDROCARBONS AT CHEAPSIDE, WALPOLE SOUTH SCHOOL AND NANTICOKE ROAD FOR 1979.

* Data prepared for G. Miller MP in Haldimand Norfolk region

FIGURE 1

MONITORING STATIONS IN NANTICOKE REGION

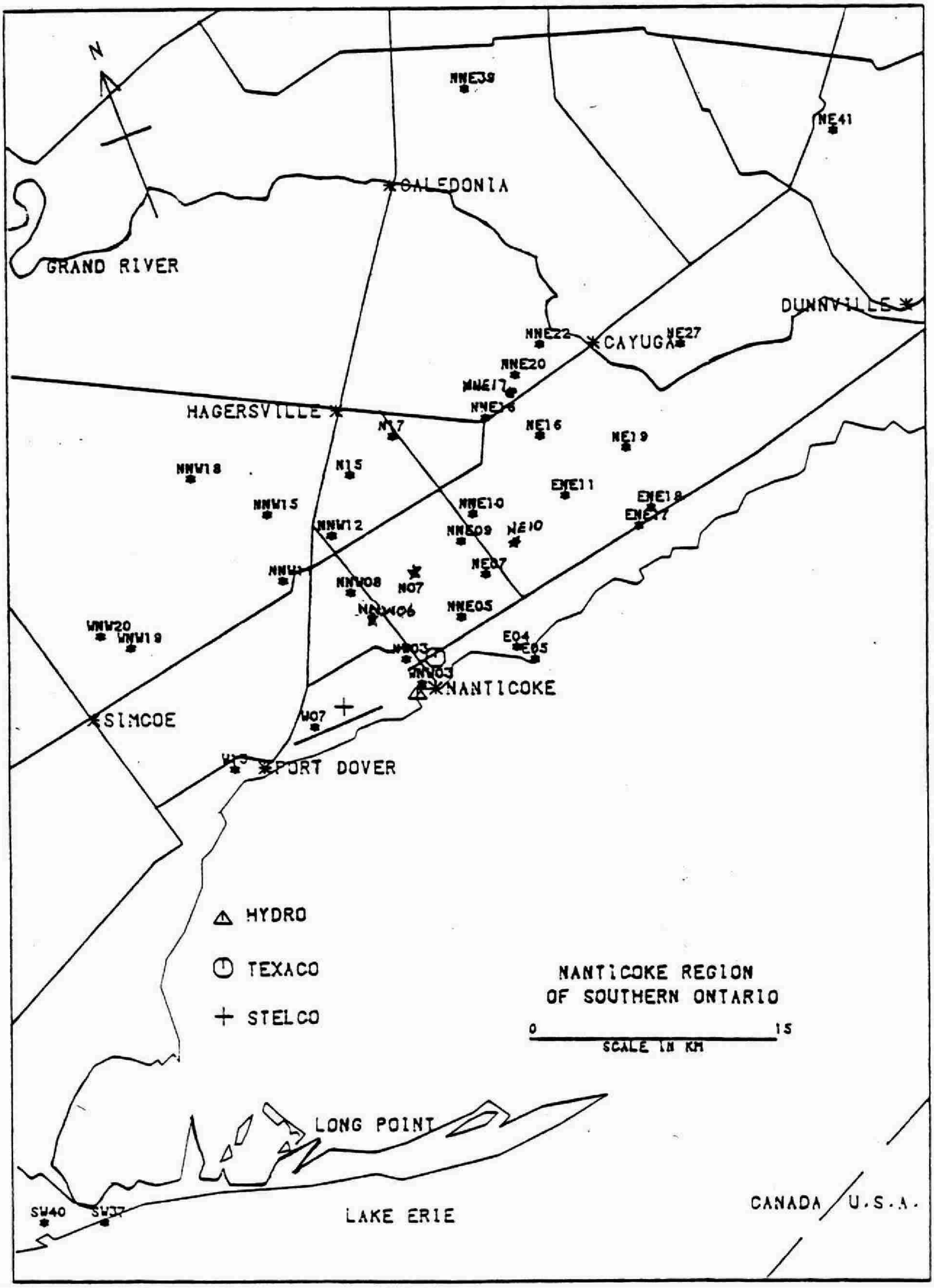

Table 1

Station Identity

Geographical Id	Site Name
SW37	Long Point Park
NNW08	Nanticoke Road
N07	Sandusk
NNE05	Walpole South School
NNE10	Cheapside
NNE39	Binbrook West
NNW03	Nanticoke Village
SW40	Big Creek
W07	Dogs Nest East
NNE22	Dufferin North
NE16	Fisherville North
NE27	Canfield South
NE41	Canboro East
NNW06	Stelco North
NW03	Nanticoke North
E04	Peacock Point Park
NNW18	Villa Nova
ENE17	Rainham Centre South
WNW19	Simcoe Horticultural
N15	Garnet
NNE09	Dry Creek
NNE16	Balmoral
NNE20	Decewsville
NE19	Kohler Road
ENE11	Selkirk
E05	Peacock Point
N13	Port Dover
WNW20	Bloomsburg
NNW11	Jarvis
NNW15	Livingston
N17	Hagersville South
ENE18	Rainham Center

Table 2

Sulphur Dioxide (SO2) Data Summary by Station - 1980 & 1981

Station ID	Hourly Minimum		Hourly Maximum		Daily Maximum		Annual Average		% Valid Data		# Monitoring Hours		# Exceedance of AQC	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
WNW19	0	0	90	210	34	39	7	4	89.3	94.0	8732	8661	0	0
NNE10	0	0	260	300	25	49	5	5	97.0	94.8	8781	8617	1	4
N07	0	0	140	450	29	53	4	3	95.9	93.6	8784	8760	0	3
W15	0	0	260	320	20	47	3	4	84.3	96.5	8784	8760	1	1
NNE05	0	0	300	310	51	55	4	6	94.2	89.7	8784	8760	2	2
NNE09	0	0	250	1131	43	68	6	5	90.3	93.9	8784	8760	0	4
NNE16	0	0	410	410	44	62	6	5	93.4	93.5	8784	8760	2	1
NNE20	0	0	310	170	40	51	5	4	94.4	89.1	8784	8760	1	0
NE19	0	0	190	150	39	52	5	5	92.0	92.9	8784	8760	0	0
ENE11	0	0	140	190	25	50	3	4	75.7	88.3	8784	8760	0	0
ENE18	0	0	100	90	25	45	4	4	88.0	92.0	8784	8760	0	0
E05	0	0	110	260	35	57	6	4	80.8	85.8	8784	8760	0	1
W13	0	0	110	100	33	56	4	3	91.9	95.4	8784	8760	0	0
WNW03	0	0	160	140	42	52	4	3	95.7	96.5	8784	8760	0	0
NNW20	0	0	160	240	41	37	3	4	86.0	60.0	8784	8760	0	0
NNW08	0	0	230	300	50	49	4	4	96.6	86.6	8784	8760	0	2
NNW11	0	0	200	220	34	45	4	4	95.1	84.0	8784	8760	0	0
NNW15	0	0	160	230	38	49	4	4	93.7	93.0	8784	8760	0	0
SW37	0	0	52	197	28	61	3	6	93.5	91.0	7665	7547	0	0
NNE39	0	0	99	301	34	44	5	6	86.4	94.7	6305	7871	0	1

Concentrations are in ppb
Hourly AQC for SO2 is 250 ppb
Daily AQC for SO2 is 100 ppb

Table 3

Ozone (O3) Data Summary by Station - 1980 & 1981

Station Id	Hourly Minimum		Hourly Maximum		Annual avg		% Valid Data		# Monitoring Hours		# Exceedances of AQC	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
SW37	0	0	123	129	33	31	87.4	91.9	7678	8323	225	159
WNW19	0	0	99	111	26	29	93.0	91.9	8169	8638	45	138
NNE39	0	0	102	103	23	24	74.0	96.2	6496	8627	15	44

Concentrations are in ppb
Hourly AQC for Ozone is 80ppb

Table 4

Nitrogen Dioxide (NO2) Data Summary by Station - 1980 & 1981

Station Id	Hourly Minimum		Hourly Maximum		Annual avg		% Valid Data		# Monitoring Hours		# Exceedances of AQC	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
SW37	0	0	52	58	7	7	67.9	N/A	6509	7569	0	0
NNE39	0	0	63	74	10	10	98.9	N/A	7284	6344	0	0
NO7	0	0	57	66	9	8	58.4	N/A	7248	4930	0	0
WNW19	0	0	90	130	12	22	96.3	92.0	8763	8563	0	0
NNE10	0	0	60	100	8	10	97.8	98.9	7745	8760	0	0

Concentrations are in ppb
Hourly AQCfor NO2 is 200ppb
N/A -- not available

Table 5

Total Reduced Sulfur (TRS) Data Summary by Station - 1980 & 1981

Station Id	Hourly Minimum		Hourly Maximum		Annual avg		% Valid Data		# Monitoring Hours	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
NNE10	0	0	14	7	0.5	0.4	76.0	92.3	3886	4791
NNE05	0	0	9	30	0.3	0.3	67.9	95.1	4462	7801
NNW08	0	0	34	7	0.3	0.3	71.3	97.2	5733	7618
WNW03	0	0	11	36	0.8	0.6	61.4	97.2	899	7714

Concentrations are in ppb

Table 6

Carbon Monoxide (CO) Data Summary by Station - 1980 & 1981

Station Id	Hourly Minimum		Hourly Maximum		Annual avg		% Valid Data		# Monitoring Hours		# Exceedances of AQC	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
SW37	0	0	6	2	0.1	0.2	90.7	94.7	7971	8427	0	0
NNE39	0	0	3	2	0.1	0.1	88.7	98.9	7176	8713	0	0

Concentrations are in ppm
Hourly AQC for CO is 30ppm

Table 7

Non-Methane (NMHC) Data Summary by Station - 1980 & 1981

Station Id	Hourly Minimum		Hourly Maximum		Annual avg		% Valid Data		# Monitoring Hours	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
NNE10	0	0	125	36	4	7	74.2	89.9	6521	8224
NNE05	0	0	77	31	6	5	77.8	97.1	6832	7998
NNW08	0	3	18	19	7	8	76.4	95.8	6710	8253

Concentrations are in .1ppm

Table 8

Methane (CH4) Data Summary by Station - 1980 & 1981

Station Id	Hourly Minimum		Hourly Maximum		Annual avg		% Valid Data		# Monitoring Hours	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
[illegible]	2	10	28	25	14	15	78.8	91.1	6921	8352
NNE05	9	11	59	55	14	14	81.0	98.2	7118	7937
NNW08	7	8	32	39	15	15	78.3	92.9	6874	8258

Concentrations are in .1ppm

Table 9

Total Suspended Particulate (Tsp) Data Summary by Station

Station	Minimum conc		Maximum conc		Geometric mean		Exceedances of AQC		# Samples	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
SW40	N/A	11	N/A	97	N/A	34	N/A	0	N/A	60
NNE39	9	2	116	88	43	35	0	0	56	61
NNE05	9	14	103	91	40	36	0	0	53	60
N17	5	12	104	129	43	39	0	1	62	61
E04	11	14	78	104	34	33	0	0	54	61
W07	15	9	99	155	39	32	0	1	84	122
NNW18	8	13	91	119	37	34	0	0	60	61
ENE17	11	10	77	68	36	33	0	0	47	61
NE27	11	14	103	121	46	38	0	1	62	61
NE16	9	12	111	121	46	39	0	1	58	61
NE41	9	10	107	141	41	37	0	1	62	61
NNE22	13	11	110	124	43	35	0	1	60	61
NW03	10	8	122	184	41	36	1	1	81	119
NNW06	14	6	66	331	29	36	0	3	24	122

N/A - Not available
Concentrations are in ug/m3
Daily AQC of Tsp is 120 ug/m3

Table 10

PH Data Summary by Station - 1980 & 1981

Station Id	Maximum		Minimum		Volume Weighted Mean		# of Samples	
	1980	1981	1980	1981	1980	1981	1980	1981
W07	4.4	7.2	3.8	3.7	4.1	4.2	11	12
NE27	5.1	7.0	3.9	3.8	4.0	4.1	9	11
NNW18	4.6	4.3	4.0	3.7	4.2	4.0	11	12
NE41	5.2	4.5	3.9	3.9	4.2	4.2	10	12
NNE22	4.8	4.4	4.1	3.6	4.2	4.1	9	12
NNE39	4.9	4.7	4.0	3.9	4.3	4.2	11	12
SW40	4.5	N/A	4.3	N/A	4.4	N/A	2	N/A

N/A - Not available
Concentrations are in mg/l

	DATE DUE		